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FINAL REPORT ON

ENGINEERING AND PRODUCTIZATION OF AN INTEGRATED FAMILY OF BACKWARD WAVE OSCILLATORS

VOLUME - TWO: APPENDICES

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NOTICES

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VOLUME II

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APPENDIX I

M-BWO DESIGN AND TEST SPECIFICATIONS

SEP 1 1963

THIS SHEET OF TEST LIMITS CONFORMS TO SPECIFICATION MIL-E-1D

Description: M-type, BWO, CW, Electrically Tunable, Wide Band Sole Modulable, Permanent Magnet, Liquid Cooled.

Definitions: The following symbols and corresponding definitions shall apply:

Symbol	Tube Element
b1	Accelerator
b2	Delay Line
g	Grid
so	Sole
Eb2/Fx	Adjust delay line voltage to obtain the indicated frequency Fx.
Eso/Fx	Adjust sole voltage to obtain the indicated frequency Fx.
Eb1/Ib2	Adjust accelerator voltage to obtain indicated delay line current.

All voltages are given with respect to the cathode.

This specification is written in three parts. Tubes tested to this specification may be optimized to one or more parts. Procuring agencies should specify only the portions they need to meet their requirements. Part I defines tests on the basic family at delay line currents (I_{b2}) of 300 mA. Part II defines test on some of the bands at I_b = 500 mA. Tubes designed for this current can be optimized and tested for both Parts I and II, if required. Part III defines tests on tubes designed for particularly high efficiency at the 300 mA operation.

Frequency

Tube Number	1	2	3	4	5	6	7	8	9
Fa	1000	1300	1800	2500	3500	4800	6500	8500	4360
Fb	1100	1440	1990	2765	3840	5235	7015	9125	4745
Fc	1200	1575	2175	3025	4175	5675	7525	9750	5135
Fd	1300	1715	2365	3290	4515	6115	8040	10375	5525
Fe	1400	1850	2550	3550	4850	6550	8550	11000	5910

Absolute Ratings

Parameter	Units	(Note A) Max.	Min.	Tube Number	Notes
Ef	Volts	6.8	---	All	
Eb2	Volts	5300	2000	All	B
Eb1	Volts	2100	---	All	B, J
Eso	-Volts	3500	900	All	B
Eg	-Volts	1000	---	All	B
I_{b2}	mA	525	---	1	J, M
		325	---	2-6, 9	J, M
		300	---	7,8	J, M
t_k	Sec.	---	60	All	---
VSWR		4:1	---	All	---

Parameter	Units	Max.	Min.	Tube Number	Notes
Tube Body Temperature	°C	150	---	All	D
Electrical Input Pressurization	psia	100	---	All	I
Coolant Pressure	psia	100	---	All	---
RF Output Pressure	psia	45	---	6,7,8,9	---
Design Ratings					
Ef	Volts	6.6	6.0	All	---
Eb2	Volts	5200	2000	All	B
Eb1	Volts	2100	800	All	B, J
Ib1	mA	+3	0	All	---
Eso	-Volts	3400	900	All	B,O
Iso	mA	+5	-20	All	N
Eg	-Volts	700	100	All	B
Ig	mA	+3	-3	All	---
Ib2	mA	500	---	1	M
		300	---	1 to 9	L,J,M
tk	Sec.	---	60	All	K
VSWR		2.1	---	All	G
Tube Body Temperature	°C	150	---	All	D

Storage, Handling and Installation		
Cooling, Liquid: Note C	Input Connections:	Note H
Magnet Isolation: Note E	Weight:	1,2,3 - 28 lbs. max.
Vibration, Shock: Note F		4, 5 - 25 lbs. max.
		6 to 9 - 17 lbs. max.

Note A: These ratings cannot be used simultaneously and no individual rating should be exceeded. The requirements of MIL-E-1D, paragraph 6.5 apply.

Note B: Delay line, sole and grid voltages must be within the indicated limits before the accelerator voltage can be applied. The accelerator voltage shall always be less than the delay line voltage.

Note C: The tube will be adequately cooled with Dimethyl Polysiloxane silicone fluid, per Mil-S-21568A, (20 centistokes viscosity at 25°C) at a flow rate of one gallon per minute with a maximum inlet oil temperature of 100°C. Other coolants may be used -- the tube manufacturer should be consulted.

Note D: Temperature to be measured at the points indicated on the electron tube outline drawing.

Note E: In shipping, storage, handling and installation of the tube, care must be exercised to prevent demagnetization. Energized magnets similar to the tube magnet shall not be brought closer than twelve (12) inches from the tube magnet except in the case where the two magnets are in a side by side repelling relationship where the spacing may be reduced to six (6) inches. Ferro magnetic material should not be brought closer than six (6) inches, from the tube magnet. Certain exceptions to this may be tolerated, depending upon size, shape

Note E: and location of the material. The tube manufacturer shall be consulted for any (Con't) exceptions.

Note F: Reasonable care must be exercised in the transportation, handling and installation of the tube to avoid imparting stress greater than that required by this specification.

Note G: The tube may require a load isolator at load VSWR values above 1.5 to eliminate power or frequency discontinuities. The tube shall not be damaged when operated into a mismatch load with a VSWR of 4 to 1.

Note H: See tube outline drawing (Note 31).

Note I: At ambient air pressures less than 10 psia, means must be provided to insulate the electrical input connections against voltage breakdown. The tube manufacturer should be consulted for details.

Note J: This limit may be exceeded for applications with maximum duty of 0.25 averaged over a 1 sec. interval. The peak current shall not exceed twice the average current specified. Consult tube manufacturer for details.

Note K: The heater voltage may be applied in the following manner:
Step 1 -- heater voltage of 1.8 ± 10% volts for 15 seconds minimum.
Step 2 -- 6.3 ± 5% volts for 45 seconds minimum.

Note L: See Note 30.

Note M: This limit may be exceeded under CW operation by 20% at Fa for short term test requirements. Consult tube manufacturer for details.

Note N: This value may be increased to -30 ma for 500 mA operation in accordance with Part II of this specification.

Note O: The sole voltage will be permitted to be below its specified range to zero volts for a duration of 1 second maximum. This test may be performed at a maximum duty cycle of 10% over a period of 1 minute. Consult the tube manufacturer for details.

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
1.9.2	Dimensions:	Per Outline Drawing Note 31	All				
1.5	Holding Period:	t = 24 hrs. (Min.)	All				
1.9 8	Salt Spray Corrosion:	Omit	All				
---	**Operational Vibration:	Note 1					
---	**Shock:	Acceleration 15g;Duration 11±1 milli-second; 3 mutual-ly perpendicular planes;5 shocks in each direction in each plane;no volt-age; Notes 2,27,31	All				
---	**Low Frequency Vibration:	Frequency:5-55 CPS Range Period:1 Min. Excursion:.06 inch (Total) Planes: 3 (Notes 31,27) Test Duration 100 Minutes. No Voltages (Note 2)					
---	**High Frequency Vibration:	Frequency:55-1500 CPS.Range Period; 20 Min.Acceleration:5g Planes:3(Notes 27,31) Test Cycles: 12 (each plane) No Voltages (Note 2)					
4.9.13	Electrical Input Pressure Test:	Silicon fluid P = 100 psia	All			No leaks	
---	Cooling Jacket Drying:	Note 3	All				
---	Cooling Jacket Pres-sure Test:	Cooling Outlet closed;Input pressure:100 psia	All			No leaks	

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
4.9.11	RF Output Pressure:		6,7,8,9			No leaks	
---	**Coolant Flow Test:	F=1.0 gpm Notes 4,5	All	ΔP:	8	13	psia
4.10.8	**Heater Current Test:	Ef=6.3 volts t_k=60 sec(min.) Note 7	All	If:	1.6	4.0	amps
4.10.14.1	**Accelerator Capacity Test:	Note 8	All	Cb1:		25	mmfd
4.10.14.1	**Sole Capacity	Note 8	All	Cso:	40	72	mmfd

Part I (Tube Numbers 1-6)

Tube Type Numbers

Band	1	2	3	4	5	6	7	8
Litton	L-3721	L-3722	L-3723	L-3724	L-3725	L-3726	L-3727	L-3728
Raytheon	QKA1250	QKA1251	QKA1252	QKA1253	QKA1254	QKA1255	QKA1256	QKA1257

Oscillation Test Conditions Note 9

---	Heater Warmup:	t_k = 60 Sec Note 7	All
---	Heater Voltage:	6.3 volts Note 26	All
---	Load Standing Wave Ratio:	VSWR=1.1 Max.	All
---	Beam Current:	I_{b2}=300 mA I_{b2}=275 mA Notes 10,30	1,2,3,4,5 6,7,8
---	Sole Voltage:	Eso2 Notes 10,28 Eso1 Notes 10,29	
---	Ambient & Coolant Temp.:	Note 28	

Part I (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	Grid Voltage:	Notes 10, 11					
	Oscillation (1)	Note 9					
	Delay line Voltage:	Note 19	All	E_{b2}:	2300	2600	volts
4.10.7.3.2	Tunable Frequency:	Eso/Fa,Fc Note 17	All	E_{so}:	900	3400	volts
---	Sole Voltage Excursion:	eso/Fc-Fa Note 14	All	eso:	---	1800	volts
---	Accelerator Voltage:	Eb1/Ib2 Note 12, 13	All	E_{b1}:	900	1900	volts
---	Accelerator Current:	Note 13	All	I_{b1}:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Ib2 Notes 12,13	1	Po:	200	---	watts
			2	Po:	200	---	watts
			3	Po:	200	---	watts
			4	Po:	180	---	watts
			5	Po:	180	---	watts
			6	Po:	165	---	watts
			7	Po:	150	---	watts
			8	Po:	150	---	watts
4.16.3.6	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6, 15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6, 16	1,2,3,4,5				
			6,7	Pr:	15	---	db
			8	Pr:	20	---	db
	Oscillation (2)	Note 9					
---	Delay line Voltage:	Note 19	All	E_{b2}:	3000	3300	volts

Part 1 (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Uni
4.10.7.3.2	Tunable Frequency:	Eso/Fb,Fd Note 17	All	Eso:	900	3400	vol
---	Sole Voltage Excursion:	eso/Fd-Fb Note 14	All	eso:	---	1800	vol
---	Accelerator Voltage:	Eb1/Ib2 Notes 12,13	All	Eb1:	900	1900	vol
---	Accelerator Current:	Note 13	All	Ib1:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Ib2 Notes 12, 13	1	Po:	200	---	wat
			2	Po:	200	---	wat
			3	Po:	200	---	wat
			4	Po:	180	---	wat
			5	Po:	180	---	wat
			6	Po:	165	---	wat
			7	Po:	150	---	wat
			8	Po:	150	---	wat
---	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6,16	1,2,3,4 5,6,7	Pr:	15	---	db
			8	Pr:	20	---	db
	Oscillation (3)	Note 9					
---	Delay line Voltage:	Note 19	All	Eb2:	3700	4000	volt
4.10.7.3.2	Tunable Frequency:	Eso/Fc,Fe Note 17	All	Eso:	900	3400	volt
---	Sole Voltage Excursion:	eso/Fe-Fc Note 14	All	eso:	---	1800	volt
---	Accelerator Voltage:	Eb1/Ib2 Notes 12, 13	All	Eb1:	900	1900	volt
---	Accelerator Current:	Note 13	All	Ib1:	0	+3	mA

Part I (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
1.16.3.6	Power Output:	Eb1/Tb2 Notes 12,13	1	Po:	200	---	watts
			2	Po:	200	---	watts
			3	Po:	200	---	watts
			4	Po:	180	---	watts
			5	Po:	180	---	watts
			6	Po:	165	---	watts
			7	Po:	160	---	watts
			8	Po:	150	---	watts
---	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output	Notes 6,16	1,2,3,4,5,6,7	Pr:	15	---	db
			8	Pr:	20	---	db
	Oscillation (4)	Note 9					
4.10.7.3.2	Tunable Frequency:	Eb2/Fb,Fd	All	Eb2:	2300	4000	volts
				Eso2:	1400	2500	volts
		Eso/Fa,Fb		Eso:	900	Eso2	volts
		Eso/Fd,Fe		Eso:	Eso2	3400	volts
---	Accelerator Voltage:	Eb1/Tb2 Note 13	1,2,3,4,5 6,7,8	Eb1:	900	1900	volts
---	Accelerator Current:	Note 13	All	Ib1:	0	+3	mA
---	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
4.16.3.6	Power Output:	Eb1/Tb2 Note 13	1	Po:	200	---	watts
			2	Po:	200	---	watts
			3	Po:	200	---	watts
			4	Po:	180	---	watts
			5	Po:	180	---	watts
			6	Po:	165	---	watts
			7	Po:	150	---	watts
			8	Po:	150	---	watts
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---

Part I (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	**Spurious Output Ratio:	Notes 6,16	1,2,3,4,5				
			6,7	Pr:	15	---	db
			8	Pr:	20	---	db
	**Oscillation (5)	Note 9					
4.10.7.3.2	Tunable Frequency:	Eb2/Fa,Fe	All	Eb2:	2000	5200	volts
---	Sole Voltage:	Eso1 Notes 10,29	All	Eso1:	1400	2400	volts
---	Accelerator Voltage:	Eb1/Ib2 Note 13	1,2,3,4,5 6,7,8	Eb1:	900	1900	volts
---	Accelerator Current:	Note 13	All	Ib1:	0	+3	mA
---	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
4.16.3.6	Power Output:	Eb1/Ib2 Note 13	1	Po:	200	---	watt
			2	Po:	200	---	watt
			3	Po:	200	---	watt
			4	Po:	180	---	watt
			5	Po:	180	---	watt
			6	Po:	165	---	watt
			7	Po:	150	---	watt
			8	Po:	150	---	watt
---	Frequency Continuity:	VSWR=1.5 Notes 6, 15	All	MFB:	---	0	---
---	Spurious Output Ratio:	Notes 6,16	1,2,3,4 5,6,7	Pr:	15	---	db
			8	Pr:	20	---	db
	Special Tests	Note 9					
4.16.5	*Pulling:	Eso:Eb2/Fa, Fc,Fe Note 20	All	ΔF:	---	25	Mc
---	*Amplitude Modulation:(I)	ΔPo = ± 25% Eso/Fa	All	ΔEb1:	---	±300	volt

Part I (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
	*Amplitude Modulation:(II)	Note 32	All			Note 32	
---	**Thermal-Frequency Drift:	Notes 18,21	All	ΔF:	---	1/4% of Fc	Mc
	*Sole Current:	Fd (Osc.3) Note 33	All	i_{so}:	---	+5	mA
---	**Thermal-Frequency Transient Time:	Note 25	All	T:	---	2	Min.
4.11	Life Test						
	Intermittent Life Test:	Group D Note 22	All	T:	1000	---	Hour
	Life Test End:	Note 23	All	E_{b1}:	---	2000	volts
				I_{b1}:	---	+4	mA
				I_g:	-4	+4	mA
				Po:	Note 24		watts

Part II (Tube Number 1)

Tube Type Numbers

Band	1
Litton	L-3721
Raytheon	QKA1250-1

Oscillation Test Conditions Note 9

---	Heater Warmup:	t_k=60 Sec Note 7
---	Heater Voltage:	6.3 volts Note 26
---	Load Standing Wave Ratio:	VSWR=1.1 Max.
---	Beam Current:	I_{b2}=500 mA Note 10, 30
---	Sole Voltage:	E_{so2} Notes 10,28

Part II (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	Ambient & Coolant Temp.:	Note 28					
---	Grid Voltage:	Notes 10, 11					
	Oscillation (1)	Note 9					
	Delay Line Voltage:	Note 19		E_{b2}:	2300	2600	volts
4.10.7.3.2	Tunable Frequency:	E_{so}/Fa,Fc Note 17		E_{so}:	900	3400	volts
---	Sole Voltage Excursion:	e_{so}/Fc-Fa Note 14		e_{so}:	---	1800	volts
---	Accelerator Voltage:	E_{b1}/I_{b2} Notes 12,13		E_{b1}:	900	2000	volts
---	Accelerator Current:	Note 13		I_{b1}:	0	+3	mA
4.16.3.6	Power Output:	E_{b1}/I_{b2} Notes 12,13		Po:	400	---	watts
4.16.3.6	Grid Current:	Note 13		I_g:	-3	+3	mA
---	Sole Current:	Note 13		I_{so}:	-30	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15		MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6,16		Pr:	10	---	db
	Oscillation (2)	Note 9					
---	Delay line Voltage:	Note 19		E_{b2}:	3000	3300	volts
4.10.7.3.2	Tunable Frequency:	E_{so}/Fb,Fd Note 17		E_{so}:	900	3400	volts
---	Sole Voltage Excursion:	e_{so}/Fd-Fb Note 14		e_{so}:	---	1800	volts

Part II (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	Accelerator Voltage:	Eb1/Tb2 Notes 12,13		Eb1:	900	2000	volts
---	Accelerator Current:	Note 13		Ib1:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Tb2 Notes 12,13		Po:	400	---	watts
---	Grid Current:	Note 13		Ig:	-3	+3	mA
---	Sole Current:	Note 13		Iso:	-30	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15		MFB:	---	0	---
	**Spuriout Output Ratio:	Notes 6,16		Pr:	10	---	db
	Oscillation (3)	Note 9					
---	Delay line Voltage:	Note 19		Eb2:	3700	4000	volts
4.16.7.3.2	Tunable Frequency:	Eso/Fc,Fe Note 17		Eso:	900	3400	volts
---	Sole Voltage Excursion:	e_{so}/Fe-Fc Note 14		e_{so}:	---	1800	volts
---	Accelerator Voltage:	Eb1/Tbs Notes 12,13		Eb1:	900	2000	volts
---	Accelerator Current:	Note 13		Ib1:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Tb2 Note 12,13		Po:	400	---	watts
---	Grid Current:	Note 13		Ig:	-3	+3	mA
---	Sole Current:	Note 13		Iso:	-30	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15		MFB:	---	0	---

Part II (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	Accelerator Voltage:	Eb1/Ib2 Notes 12,13		E_{b1}:	900	2000	volts
---	Accelerator Current:	Note 13		I_{b1}:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Ib2 Notes 12,13		Po:	400	---	watts
---	Grid Current:	Note 13		I_g:	-3	+3	mA
---	Sole Current:	Note 13		I_{so}:	-30	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15		MFB:	---	0	---
	**Spuriout Output Ratio:	Notes 6,16		Pr:	10	---	db
	Oscillation (3)	Note 9					
---	Delay line Voltage:	Note 19		E_{b2}:	3700	4000	volts
4.16.7.3.2	Tunable Frequency:	Eso/Fc,Fe Note 17		E_{so}:	900	3400	volts
---	Sole Voltage Excursion:	e_{so}/Fe-Fc Note 14		e_{so}:	---	1800	volts
---	Accelerator Voltage:	Eb1/Ibs Notes 12,13		E_{b1}:	900	2000	volts
---	Accelerator Current:	Note 13		I_{b1}:	0	+3	mA
4.16.3.6	Power Output:	Eb1/Ib2 Note 12,13		Po:	400	---	watts
---	Grid Current:	Note 13		I_g:	-3	+3	mA
---	Sole Current:	Note 13		I_{so}:	-30	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15		MFB:	---	0	---

Part II (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
	**Spurious Output Ratio:	Note 16		Pr:	10	---	db
	Oscillation (4)	Note 9					
4.10.7.3.2	Tunable Frequency:	Eb2/Fb, Fd		E_{b2}:	2300	4000	volts
				E_{b2}:	1400	2500	volts
		E_{so}/Fa, Fb		E_{so}:	900	Eso2	volts
		E_{so}/Fd, Fe		E_{so}:	Eso2	3400	volts
---	Accelerator Voltage:	Eb1/Ib2 Note 13		E_{b1}:	900	2100	volts
---	Accelerator Current:	Note 13		I_{b1}:	0	+3	mA
---	Grid Current:	Note 13		I_g:	-3	+3	mA
---	Sole Current:	Note 13		I_{so}:	-30	+5	mA
4.16.3.6	Power Output:	Eb1/Ib2		Po:	400	----	watts
	Frequency Continuity:	VSWR=1.5 Notes 6, 15		MFB:	---	0	---
---	** Spurious Output Ratio:	Note 16		Pr:	10	---	db
	Special Tests	Note 9					
4.16.5	*Pulling:	Eso:Eb2/Fa, Fc, Fe Note 20		ΔF:	---	25	Mc
---	*Amplitude Modulation:(I)	ΔPo = ± 25% Eso/Fa		ΔE_{b1}:	---	±300	volt
---	*Amplitude Modulation:(II)	Note 32	All		Note 32		
---	**Thermal-Frequency Drift:	Notes 18, 21		ΔF:	---	1/4 of Fe	Mc
	*Sole Current:	Fd (Osc. 3) Note 33		i_{so}:	---	+ 5	mA
---	**Thermal-Frequency Transient Time:	Note 25		T:	---	2	Min.

Part II (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
	Life Test						
	Intermittent Life Test:	Group D Note 22		T:	1000	---	Hours
	Life Test End:	Note 23		E_{b1}:	---	2100	volts
				I_{b1}:	---	+4	mA
				I_g:	-4	+4	mA
				P_o:	Note 24		watts

Part III (Tubes Number 4 and 9)

Tube Type Numbers

	4	9
Band		
Litton	L-3724A	L-3729A
Raytheon	QKA1253-2	QKA1258-2

Oscillation Test Conditions Note 9

---	Heater Warmup:	t_k=60 Sec Note 7	All				
---	Heater Voltage:	6.3 volts Note 26	All				
---	Load Standing Wave Ratio:	VSWR=1.1 Max.	All				
---	Beam Current:	I_{b2}=300 mA Notes 10,30	All				
---	Sole Voltage:	E_{so2} Notes 10,28					
---	Ambient & Coolant Temp.:	Note 28					
---	Grid Voltage:	Notes 10,11					
	Oscillation (1)	Note 9					
	Delay line Voltage:	Note 19	All	E_{b2}:	2300	2600	volts
4.10.7.3.2	Tunable Frequency:	E_{so}/Fa,Fc Note 17	All	E_{so}:	900	3400	volts

Part III (Con't)

Ref.	Test	Conditions	Tube Numbers	Symbol	Min.	Max.	Units
---	Sole Voltage Excursion:	e_{so}/Fc-Fa Note 14	All	e_{so}:	---	1800	volts
---	Accelerator Voltage:	Eb1/Ib2 Notes 12, 13	All	Eb1:	800	1900	volts
---	Accelerator Current:	Note 13	All	I_{b1}:	0	+3	mA
---	Power Output:	Eb1/Ib2	9	Po:	220	---	watts
		Notes 12, 13	4	Po:	235	---	watts
4.16.3.6	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	I_{so}:	-20	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6,16	All	Pr:	15	---	db
	Oscillation (2)	Note 9					
---	Delay line Voltage:	Note 19	All	Eb2:	3000	3300	volts
4.10.7.3.2	Tunable Frequency:	Eso/Fb,Fd Note 17	All	Eso:	900	3400	volts
---	Sole Voltage Excursion:	e_{so}/Fd-Fb Note 14	All	e_{so}:	---	1800	volts
---	Accelerator Voltage:	Eb1/Ib2 Notes 12,13	All	Eb1:	800	1900	volts
---	Accelerator Current:	Note 13	All	I_{b1}:	0	+3	mA
	Power Output:	Eb1/Ib2	9	Po:	220	---	watts
		Notes 12,13	4	Po:	235	---	watts
	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	I_{so}:	-20	+5	mA

Part III (Con't)

Ref.	Test	Conditions	Tube Number	Symbol	Min.	Max.	Units
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6,16	All	Pr:	15	---	db
	Oscillation (3)	Note 9					
---	Delay line Voltage:	Note 19	All	Eb2:	3700	4000	volts
4.10.7.3.2	Tunable Frequency:	Eso/Fc,Fe Note 17	All	Eso:	900	3400	volts
---	Sole Voltage Excursion:	eso/Fe-Fc Note 14	All	eso:	---	1800	volts
---	Accelerator Voltage:	Eb1/Ib2 Notes 12,13	All	Eb1:	800	1900	volts
---	Accelerator Current:	Note 13	All	Ib1:	0	+3	mA
---	Power Output:	Eb1/Ib2 Notes 12,13	9 4	Po: Po:	220 285	--- ---	watts watts
---	Grid Current:	Note 13		Ig:	-3	+3	mA
---	Sole Current:	Note 13	All	Iso:	-20	+5	mA
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Note 6, 16	All	Pr:	15	---	db
	Oscillation (4)	Note 9					
4.10.7.3.2	Tunable Frequency:	Eb2/Fb,Fd	All	Eb2: Eso2:	2300 1400	4000 2500	volts volts
		Eso/Fa,Fb		Eso:	900	Eso2	volts
		Eso/Fd,Fe		Eso:	Eso2	3400	volts
---	Accelerator Voltage:	Eb1/Ib2 Notes 13, 12	All	Eb1:	800	1900	volts

Part III (Con't)

Ref.	Test	Condition	Tube Number	Symbol	Min.	Max.	Units
---	Accelerator Current:	Note 13	All	I_{b1}:	0	+3	mA
---	Grid Current:	Note 13	All	I_g:	-3	+3	mA
---	Sole Current:	Note 13	All	I_{so}:	-20	+5	mA
4.18.3.6	Power Output:	Eb1/Ib2	9	Po:	220	---	watts
		Notes 13	4	Po:	235	---	watts
---	Frequency Continuity:	VSWR=1.5 Notes 6,15	All	MFB:	---	0	---
---	**Spurious Output Ratio:	Notes 6,16	All	Pr:	15	---	db
	Special Tests	Note 9					
4.16.5	*Pulling:	Eso:Eb2/Fa,Fc,Fe Note 20	All	ΔF:	---	25	Mc
	*Amplitude Modulation:(1)	ΔPo = ± 25% Eso/Fa	All	ΔEb1:	---	±300	volts
	*Amplitude Modulation:(II)	Note 32	All			Note 32	
	**Thermal-Frequency Drift:	Notes 18,21	All	ΔF:	---	1/4 of Fe	Mc
	*Sole Current	Fd (Osc. 3) Note 33	All	I_{so}:	---	+5	mA
	**Thermal-Frequency Transient Time:	Note 25	All	T:	---	2	Min.
	Life Test						
	Intermittent Life Test:	Group D Note 22	All	T:	1000	---	hour.
	Life Test End:	Note 23		E_{b1}:	---	2000	volts
				I_{b1}:	---	+4	mA
				I_g:	-4	+4	mA
				Po:	Note 24		watts

Note 1: The tube shall be vibrated at an acceleration of 2 g or a double amplitude of .06 inches, whichever is limiting, from 5 to 1500 cps. The vibration frequency range shall be traversed from 5 to 1500 to 5 cps in a 20-minute period while the tube is operating CW at F_e. If any tube resonance is detected, the tube shall be vibrated at the resonance frequency for 15 minutes and shall then pass oscillations 1 through 4. If no resonance is detected, the tube shall meet the electrical requirements of this specification. The vibration cycle shall be repeated in each of three mutually perpendicular planes as defined by electron tube outline drawing.

Note 2: After this test, the tube shall meet the requirements of oscillations 1 through 4.

Note 3: Prior to shipping the tube, the cooling jacket shall be drained and dehydrated if other than silicone oil is used for test purposes. Protective covers shall be attached to the cooling jacket connections.

Note 4: The pressure difference shall be measured between the inlet and outlet connectors of the tube and includes the pressure drop of the mating fittings.

Note 5: The test coolant shall be Dimethyl Polysiloxane silicone fluid per specification MIL-S-21568A (20 centistokes viscosity at 25°C). The inlet coolant temperature to the tube shall be 85° C 5°C.

Note 6: To facilitate the measurement of the parameter for this test, the appropriate voltage may be varied dynamically over the entire or any portion of the band of this oscillation.

Note 7: The heater voltage may be applied in the following manner:

Step 1 - heater voltage of 1.8 ± 10% volts for 15 seconds minimum.

Step 2 - 6.3 ± 5% volts for 45 seconds minimum.

Note 8: The capacity shall be measured between the indicated electrode and all other electrodes connected together.

Note 9: The conditions specified under Oscillation Test Conditions apply to all Oscillation tests and Special Tests except where specifically modified.

Note 10: The operating value to be indicated on each individual tube.

Note 11: The grid voltage shall be either -100, -200, -300, -400, -500, -600 or -700 volts. For operation, the grid voltage must be set within ± 50 volts of the value indicated on the tube.

Note 12: This test shall be performed at a constant accelerator voltage which shall be determined as follows:

Step 1. Apply sinoisodal modulation to the sole bias (Eso2) to obtain the frequency extremes of this oscillation. The bias Eso2 may be varied so as not to exceed the frequency limits of the oscillation.

Step 2. Adjust the accelerator voltage to obtain the average current specified Ib2 (Note 10).

Step 3. Remove the sinoisodal modulation and tune the sole over the specified range.

Note 13: The indicated parameter shall be within the limits specified at all frequencies of this oscillation test.

Note 14: The peak-to-peak voltage necessary to tune the frequency range noted shall not exceed the value specified.

Note 15: A frequency skip is defined as a missing frequency band (MFB) in excess of 1.0 Mc/s. The specified frequency range for each test group shall be examined for missing frequency bands. The width of the missing frequency band shall be measured at the worst VSWR phase for that band with an accurance of ± 1 Mc.

Note 16: The frequency range of the indicated oscillation shall be examined for spurious power output. Any spurious power shall be below the power of the CW carrier by the power ratio (Pr) specified. The range ± 20 Mcs from the CW carrier is excluded from this test.

Note 17: The sole voltage may be controlled manually for this test.

Note 18: The Thermal Frequency Drift specified shall not be exceeded for any combination of anode inlet coolant temperature from -54°C to +100°C and ambient temperature from -54°C to +85°C. The frequency difference between the maximum and minimum frequencies measured under the four conditions of this test shall not exceed the value specified. The conditions are as follows:

1. Under the condition of anode inlet coolant temperature and tube ambient temperature of 30°C ± 10°C set the center sole voltage $E_{so}1$ to the value indicated per Note 10 and adjust E_b2 until the tube oscillation is stabilized at Fe. The tube is stabilized when the frequency difference between the maximum and minimum frequency measured over a period on one hour at intervals of five minutes shall not exceed .05% of Fe.

2. Maintain $E_{so}1$ and E_b2 at these values. Adjust the tube ambient temperature to +85°C and the anode inlet coolant temperature to +100°C. After the tube frequency has stabilized, measure the frequency and note as Fe1.

Note 18: (Con't)

3. Repeat Step 2, except adjust the tube ambient temperature to -54°C and the anode inlet coolant temperature to -54°C, and note the stabilized frequency as Fe2.

4. Repeat Step 2, except adjust the tube ambient temperature to -54°C and the anode inlet coolant temperature to +100°C, and note the stabilized frequency as Fe3.

Note 19: The delay line voltage shall be set so that the mid-frequency of oscillations 1,2, or 3 (Fb,Fc, or Fd, respectively) is obtained with the same voltage $E_{so}2$. The conditions of test shall be the same as those listed under Note 28.

Note 20: The load VSWR may be adjusted to 1.5:1 at each test frequency. The pulling figure test shall be made by continuously moving the pulling stub through all phases sufficiently fast to prevent thermal effects. This test shall be performed at Osc. 1, 2, and 3.

Note 21: The tube must be capable of voltage correction of thermal drift, and meet all test conditions of this specification, by means of a change in sole voltage above or below the value $E_{so}2$ (Note 10) as required.

Note 22: Life test shall be conducted only at highest applicable beam current. During life testing, the tube shall be operated for equal amounts of time for Oscillation 1 and Oscillation 3. Operation of the tube shall be alternated between Oscillation 1 and Oscillation 3 at least once every 48 hours. The load VSWR shall be 1.5 and shall be cycled through all phases continuously at a rate of 4 cycles per hour.

(a) Heater preheat	60 seconds maximum
(b) Oscillation	30 minutes maximum
(c) No voltage	5 minutes minimum

Time assignable to life shall be the cumulative oscillation time. All voltages except the heater voltage will be applied to the tube simultaneously (Note B). The heater voltage preheat limitation shall be observed (Note L).

Note 23: End of Life shall be determined by failure to pass any of the oscillation tests as modified by the end of life limits specified.

Note 24: The power output end of life limit shall be 80% of the minimum for each tube type at the beginning of life.

Note 25: The time allowed for the tube to reach a stabilized frequency after full beam current has been established shall not exceed the maximum specified. The tube is stabilized when the frequency difference between the maximum and minimum frequency measured over a period of one hour at intervals of five minutes shall not exceed .05% of Fe. The conditions of test shall be as stated in Note 28.

Note 26: A heater voltage of 6.3 volts can be used for production test. The tubes must, however, be capable of passing all Oscillation Tests during Design or Qualification Approval with a heater voltage anywhere in the range from 6.0 to 6.6 volts RMS.

Note 27: The planes shall be mutually perpendicular and as defined on the electron tube outline drawings.

Note 28: The fixed sole voltage E_{so2} is defined as the sole voltage recommended by the tube manufacturer for optimum tube operation under conditions of Oscillations 1, 2 and 3 CW of this specification. The conditions of test for determining E_{so2} shall be as follows:

1. Anode Cooling. Silicone fluid (20 centistokes viscosity at 25°) at a flow rate of 1 gal. ± 10% per minute and at a temperature at the anode inlet of 30° ± 10°C.

2. The external tube ambient temperature shall be 30° ± 10°C.

Note 29: The fixed sole voltage E_{so1} is defined as the sole voltage recommended by the tube manufacturer for optimum tube operation under the conditions of this oscillation test. The conditions of test for determining E_{so1} shall be the same as specified in Note 28.

Note 30: The value of delay line current is the normal value. The delay line current indicated on the metal-cal may vary ± 25 ma from the normal value.

Note 31: The following outline drawings form a part of this specification:

Tube Number	Drawing Number
1,2,3,4, and 5	B1-5
6,7,8, and 9	B6-9

Note 32: Adjust the tube for Osc.3(FC). Reduce E_{b1} from its normal operating level by 200 volts. The tube must remain in oscillation at this lower voltage level. For qualification, this test will be performed at all test frequencies of Osc. 1, 2, 3, and 4.

Note 33: Reduce the sole voltage to zero volts. (See Note O.) The sole current shall never exceed the maximum positive value specified.

AIR FORCE DRAWING B 1-5

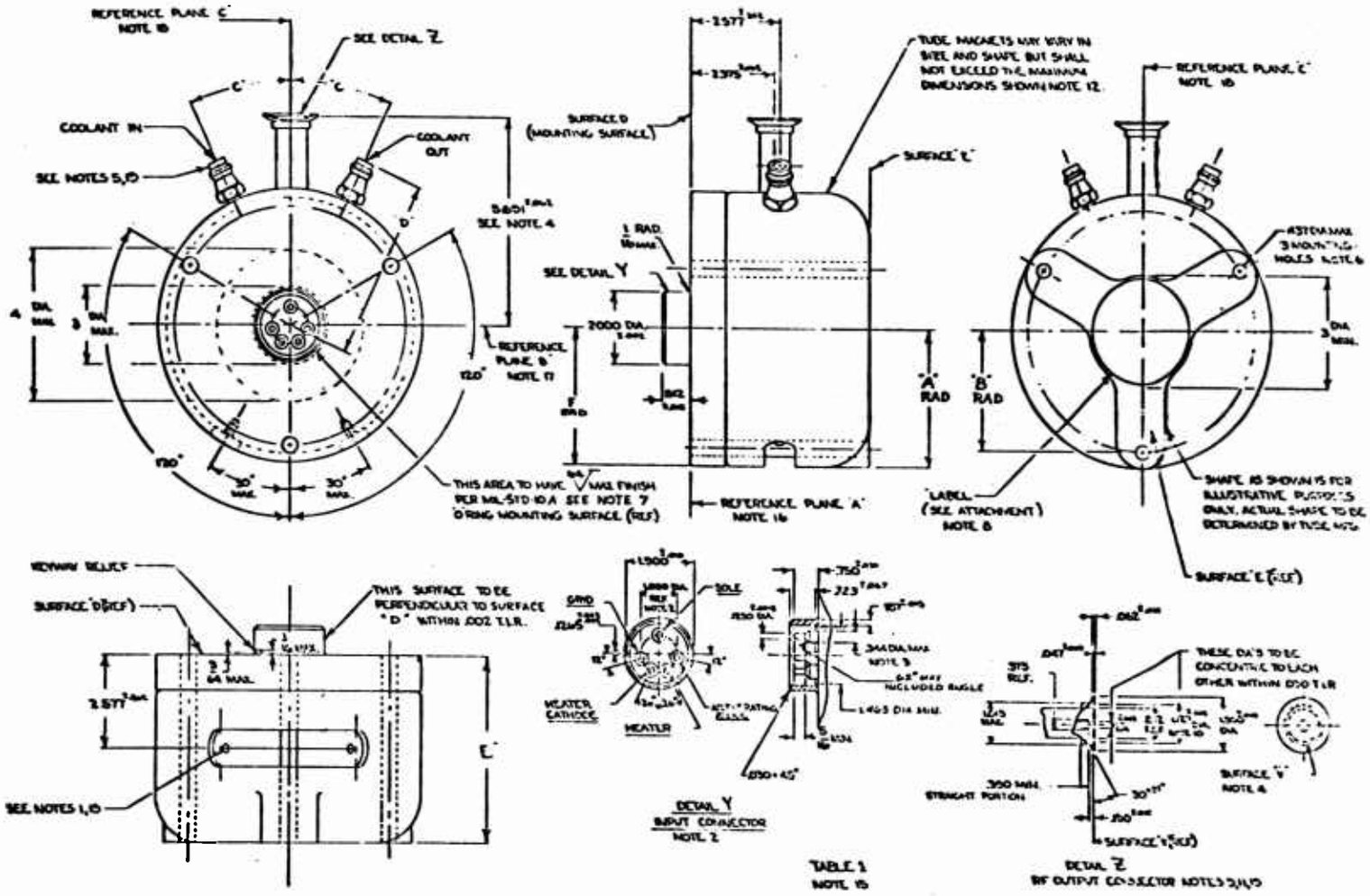
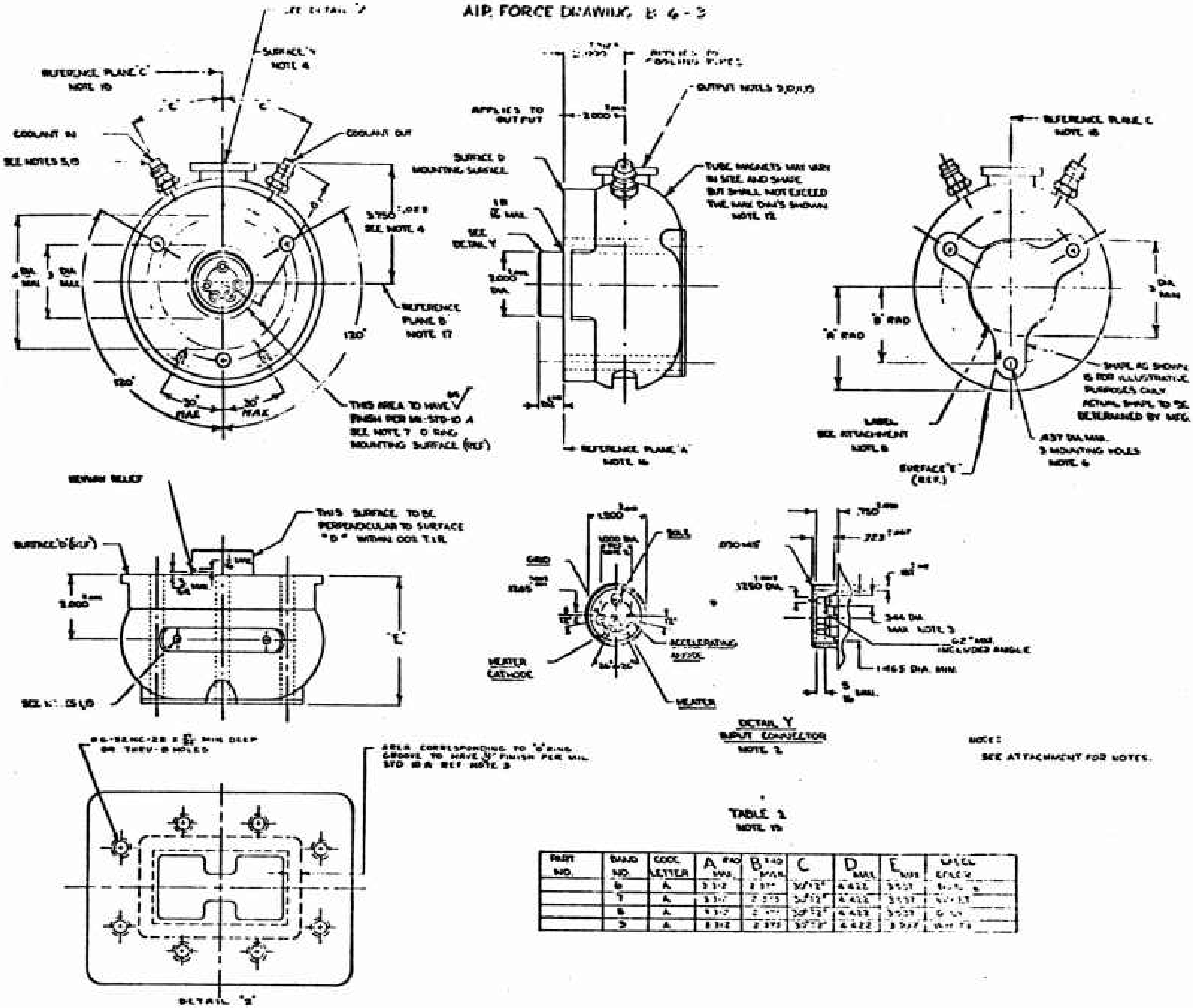


TABLE 1
NOTE 15

PART NO.	BAND NO.	CODE LETTER	A RAD MAX.	B RAD MIN.	C	D DIA.	E MAX.	LABEL COLOR	F RAD MIN.
	1	A	3.812	3.500	25°15'	4.938	5.100	BROWN	3.750
	2	A	3.812	3.500	25°15'	4.938	5.100	RED	3.750
	3	A	3.812	3.500	25°15'	4.938	5.100	ORANGE	3.750
	4	A	3.812	3.375	30°12'	4.422	4.512	YELLOW	3.312
	4	B	3.812	3.500	25°15'	4.938	5.100		3.750
	5	A	3.812	3.375	30°12'	4.422	4.512	GREEN	3.312
	5	B	3.812	3.500	25°15'	4.938	5.100		3.750

NOTE:
SEE ATTACHMENT FOR NOTES.

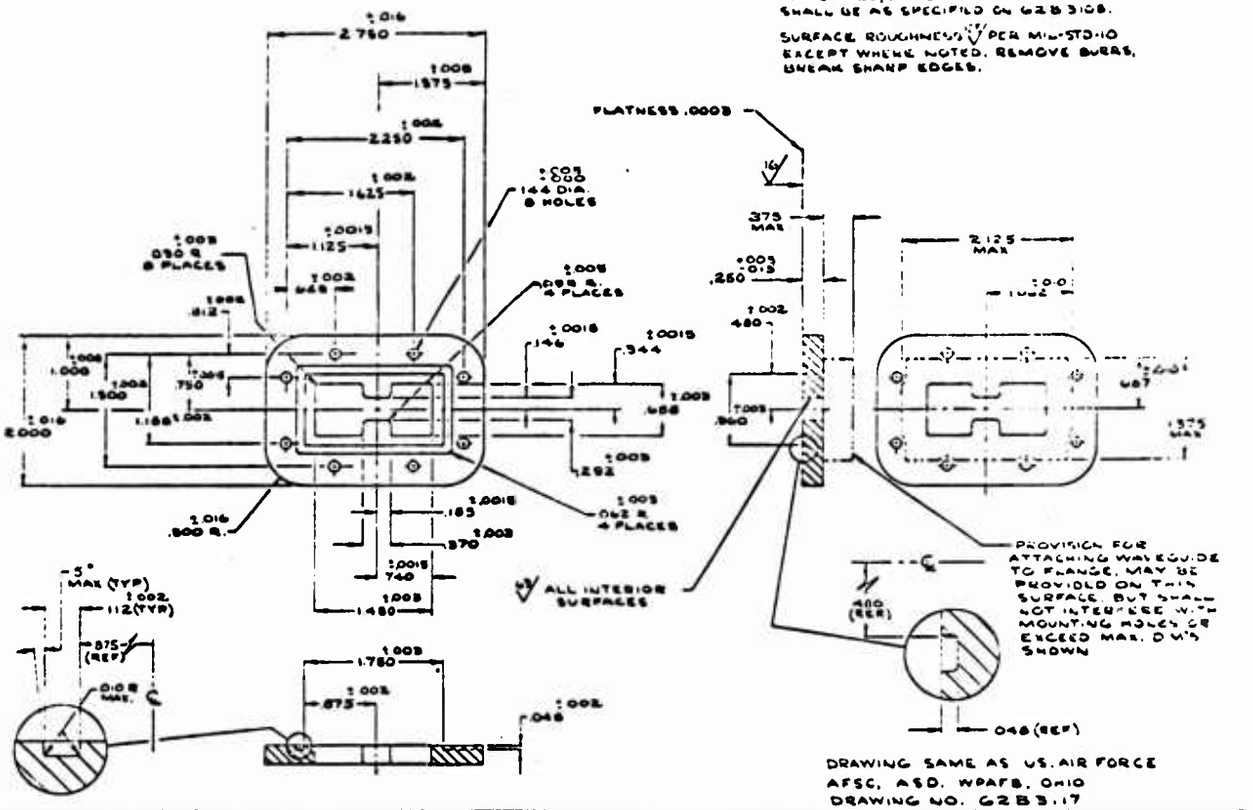
AIR FORCE DRAWING B 6-3

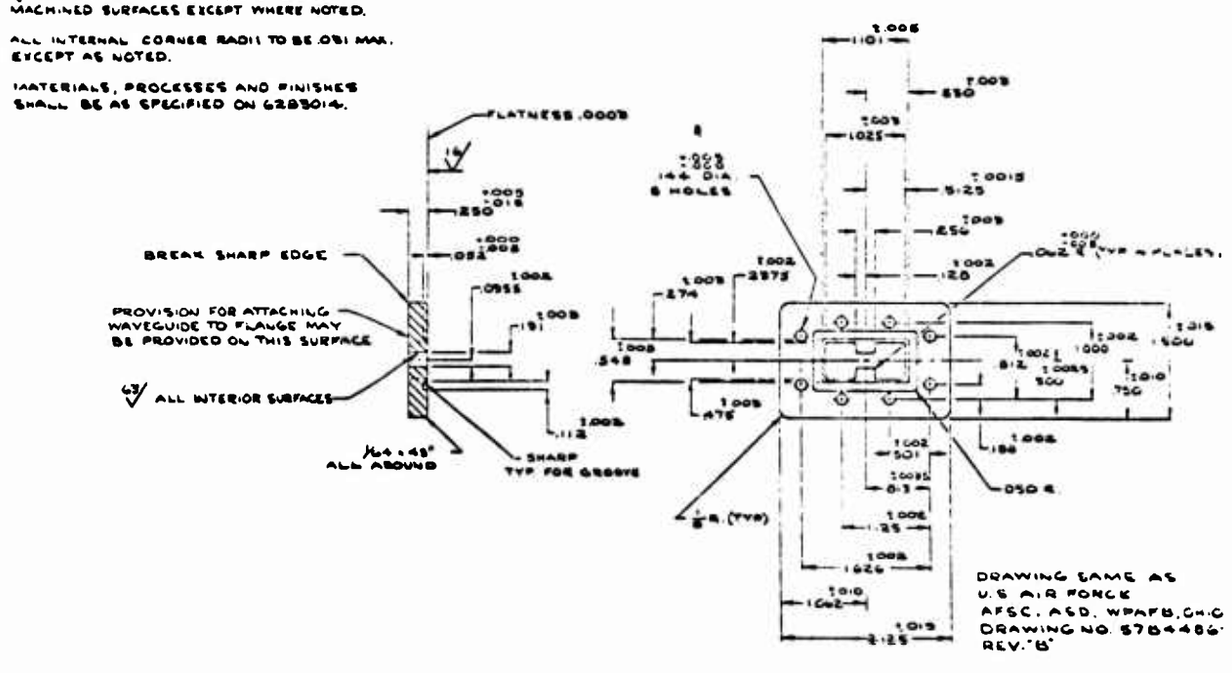


NOTE:
SEE ATTACHMENT FOR NOTES.

TABLE 1
NOTE 15

PART NO.	BAND NO.	CODE LETTER	A RAD MAX.	B RAD MAX.	C	D MAX.	E MIN.	[illegible]
	6	A	3.312	[illegible]	[illegible]	4.422	3.537	[illegible]
	7	A	3.312	[illegible]	[illegible]	4.422	3.537	[illegible]
	8	A	3.312	[illegible]	[illegible]	4.422	3.537	[illegible]
	9	A	3.312	[illegible]	[illegible]	4.422	3.537	[illegible]


MATERIALS, PROCESSES AND FINISHES SHALL BE AS SPECIFIED ON 6283108.
SURFACE ROUGHNESS 125 PER MIL-STD-10 EXCEPT WHERE NOTED. REMOVE BURRS, BREAK SHARP EDGES.
FLATNESS .0003
ALL INTERIOR SURFACES
PROVISION FOR ATTACHING WAVEGUIDE TO FLANGE, MAY BE PROVIDED ON THIS SURFACE, BUT SHALL NOT INTERFERE WITH MOUNTING HOLES OR EXCEED MAX. D.W.'S SHOWN
DRAWING SAME AS U.S. AIR FORCE AFSC, ASD, WPAFB, OHIO DRAWING NO. 6283117


125 SURFACE ROUGHNESS MIL-STD-10 FOR ALL MACHINED SURFACES EXCEPT WHERE NOTED.
ALL INTERNAL CORNER RADII TO BE .031 MAX. EXCEPT AS NOTED.
MATERIALS, PROCESSES AND FINISHES SHALL BE AS SPECIFIED ON 6283014.
FLATNESS .0003
BREAK SHARP EDGE
PROVISION FOR ATTACHING WAVEGUIDE TO FLANGE MAY BE PROVIDED ON THIS SURFACE
ALL INTERIOR SURFACES
SHARP TYP FOR GROOVE
DRAWING SAME AS U.S AIR FORCE AFSC, ASD, WPAFB, OHIO DRAWING NO. 5784486 REV. "B"

MBWO Drawing Notes

Note 1: Two #6-32 NC tapped holes whose minor diameter shall not exceed .116" for measuring cylinder temperature shall be provided. Location to be determined by the tube manufacturer except for dimensions given. A test cylinder of 0.625" diameter, engaging either one of the two tapped holes for the centrally located 1/4" max. long, number 6-32 NC-2A threaded stud, shall freely clear the magnet.

Note 2: Electrical input pins are located as shown within 0.015 inches of true geometric location.

Note 3: Material covering pins shall be of an electrical insulating type compatible with the following fluid, Dimethyl Polysloxane silicone fluid per MIL-S-21568A (20 centistokes viscosity at 25°C). The above material shall be compatible with this fluid at temperatures from -54°C to +120°C.

Note 4: The 3.750 or 5.691 dimension includes lateral and angular deviation of surface "Y". Surface "Y" shall be parallel to reference plane "B" within ± 0.015 measured at the periphery.

Note 5: Male connector to mate with female disconnect coupler, Aeroquip Corp., Jackson, Mich. Part Number 23129 or equivalent.

Note 6: The 0.437 diameter mounting holes provide clearance for 5/16 diameter non-magnetic bolts which are located as shown, within 0.015 of true geometric location. This applies to both surfaces "D" and "E".

Note 7: Surface "D" must provide a hermetic seal, and must have a maximum surface finish as specified. Surface is to be flat within 0.0005/inch diameter T.I.R.

Note 8: Label

A. Characters to be alternate Gothic 3.
B. All character sizes not designated are to be 12 point.
C. Material: 0.003 anodized aluminum nameplate per specification MIL-N-25076, type 11. Pressure sensitive adhesive must be compatible with coolant oils specified in Note 3.

Note 9: For tubes 1 through 5 dimensions 0.812 and 0.375 on rf output connector mate with and are in accordance with RG-44/U transmission line.

For tubes 6 through 8 the waveguide output mates with AF drawing 57B4486 Revision A.

For tube 9 the waveguide output mates with AF drawing 62B3117.

Note 10: For tubes 1 through 5 the axis of the 1.127 dia. to be within ± 0.030 at the intersection of surface "Y" and reference plane "C". For tubes 6 through 8 in the plane of the major axis, the waveguide opening shall be parallel to reference plane "A" within 0°- 20 maximum. As an alternate, a plane passing through hole "X" of tube flange shall be parallel to ref plane "A" within 012.

Note 11: Care must be exercised in handling and processing the tube. The tube should not be lifted by the output connector, nor should unnecessary stresses be imparted to this member. Jarring should be avoided.

Note 12: In shipping, storage, handling, and installation of the tube, care must be exercised to prevent demagnetization. Energized magnets similar to the tube magnets, shall not be brought closer than 12" from the tube magnet, except in the case where the two magnets are in a side by side repelling relationship where the spacing may be reduced to 6". Ferro-magnetic materials should not be brought closer than 6" from the tube magnet. Certain exceptions to this may be tolerated, depending on size, shape and location of the material. The tube manufacturer shall be consulted for approval of any exceptions.

Note 13: All rf band numbers to be Monsen black Gothic 612J-24PT.

Note 14: Meeting point of two colors shall not have a separation line.

Note 15: Code letters A or B following Air Force part number signify maximum tube diameter as designated in Table 1. Numeral signifies band.

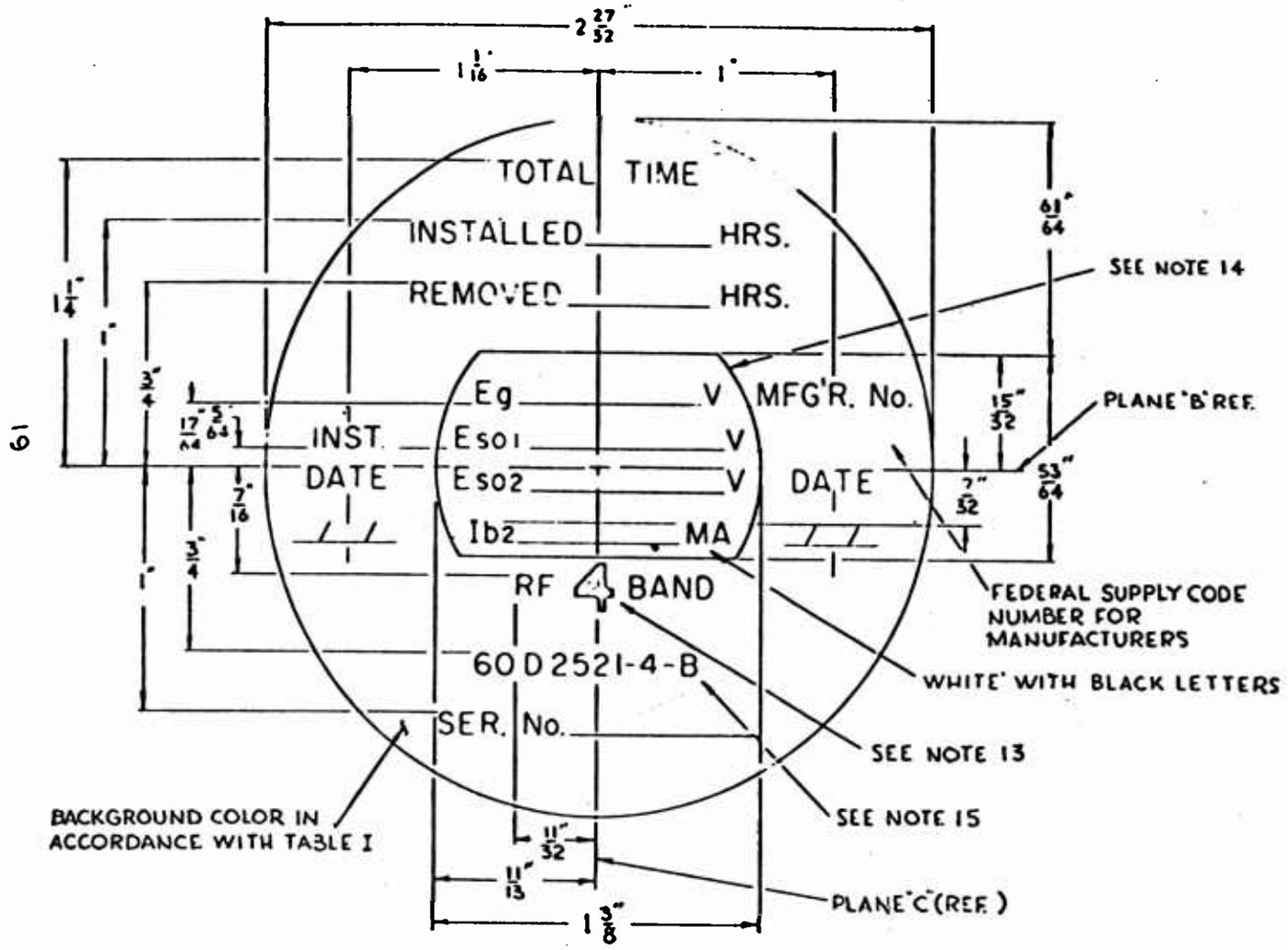
Note 16: Reference plane "A" is defined as the plane which lies on the mounting plate surface as shown.

Note 17: Reference plane "B" is defined as the plane perpendicular to plane "A" and passes through the axis of the 2.000" diameter of input connector collar and center-line of the keyway.

Note 18: Reference plane "C" is defined as the plane perpendicular to planes "A" and "B" and passes through the axis of the 2,000" diameter of input connector collar.

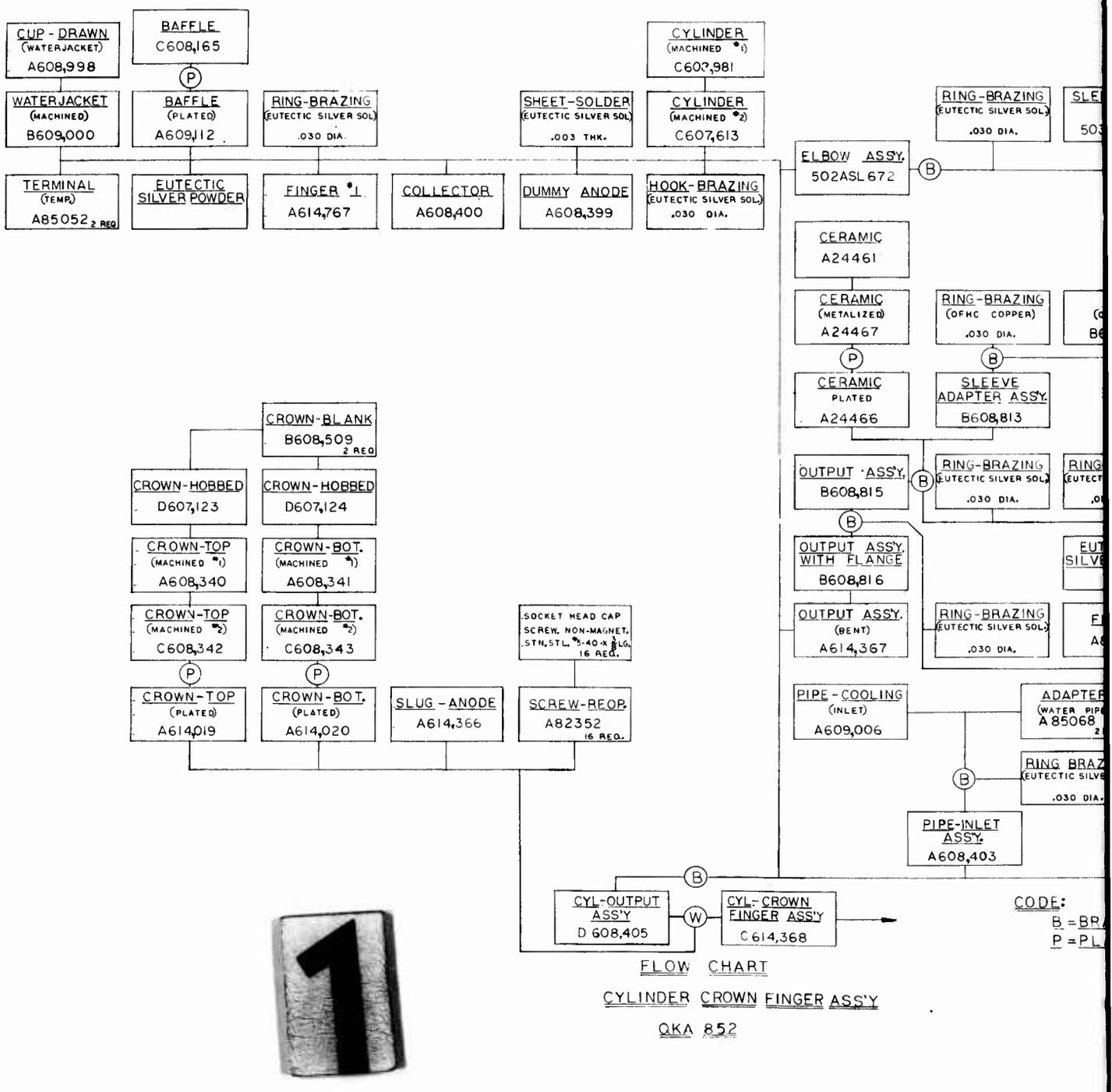
Note 19: A means of grounding shall be provided for, at one of the following locations tube body, coolant connector, or rf output connector.

A626.597


TOTAL TIME
INSTALLED HRS.
REMOVED HRS.
Eg V
Eso1 V
Eso2 V
Ib2 MA
INST.
DATE
MFG'R. No.
DATE
RF BAND
60D2521-4-B
SER. No.
SEE NOTE 14
PLANE "B" REF.
FEDERAL SUPPLY CODE NUMBER FOR MANUFACTURERS
WHITE WITH BLACK LETTERS
SEE NOTE 13
SEE NOTE 15
PLANE "C" (REF.)
BACKGROUND COLOR IN ACCORDANCE WITH TABLE I
2 27/32"
1 1/16"
1"
61/64"
15/32"
53/64"
7/32"
11/32"
11/16"
1 3/8"
1 1/4"
3/4"
7/16"
17/64"
5/64"

APPENDIX II

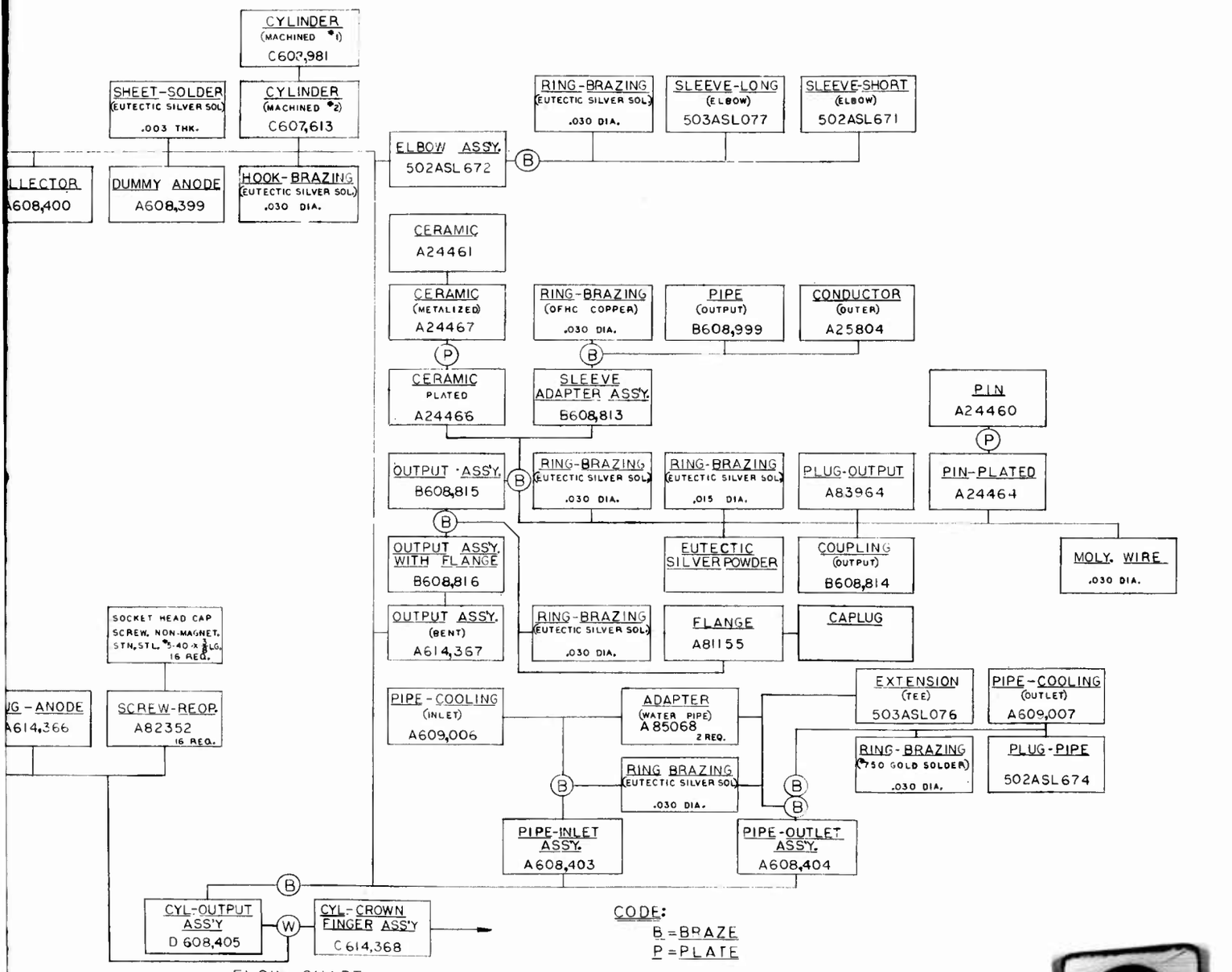
FAMILY PROCESS SPECIFICATIONS



FLOW CHART

CYLINDER CROWN FINGER ASS'Y

QKA 852

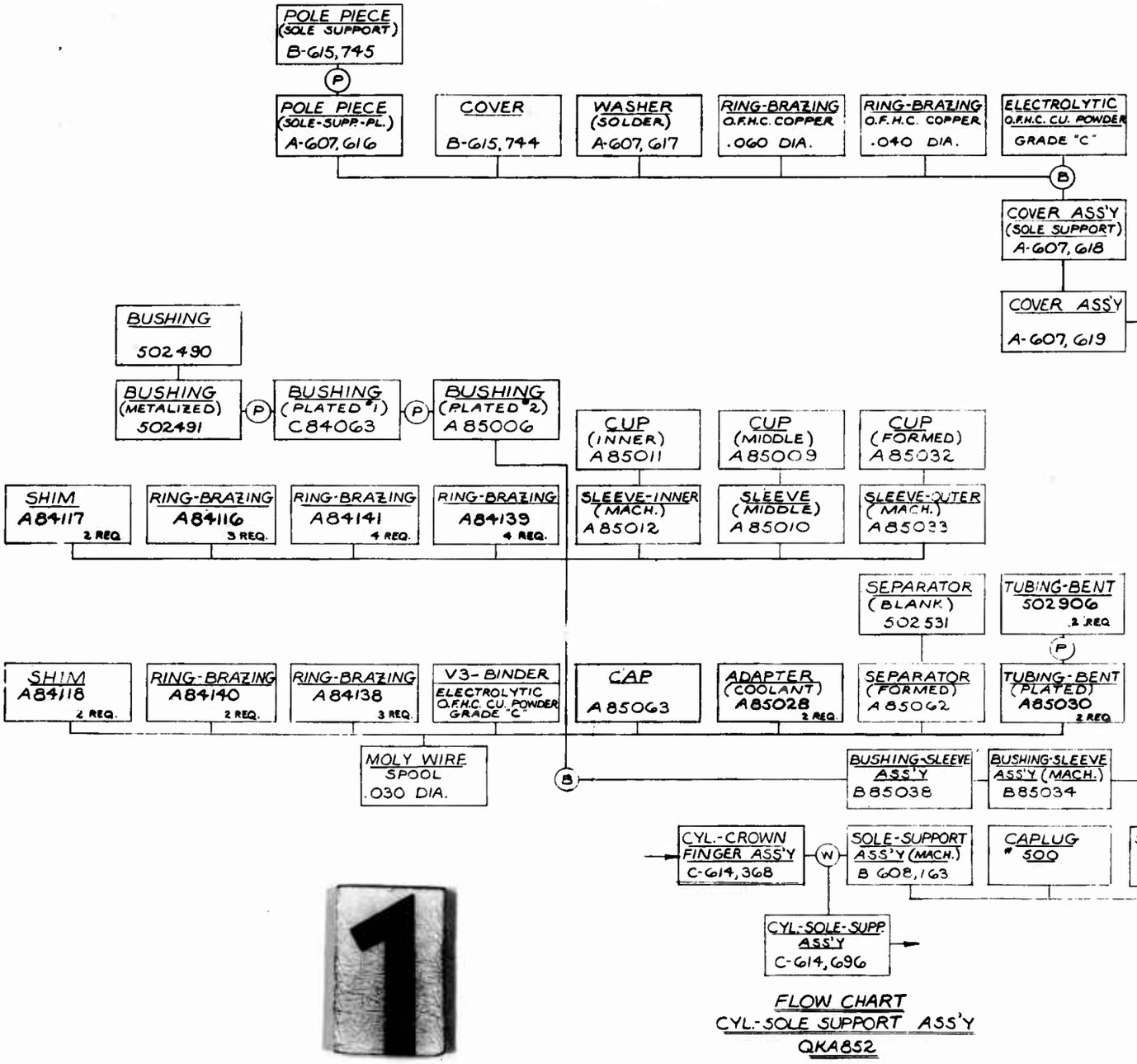


FLOW CHART

CYLINDER CROWN FINGER ASS'Y

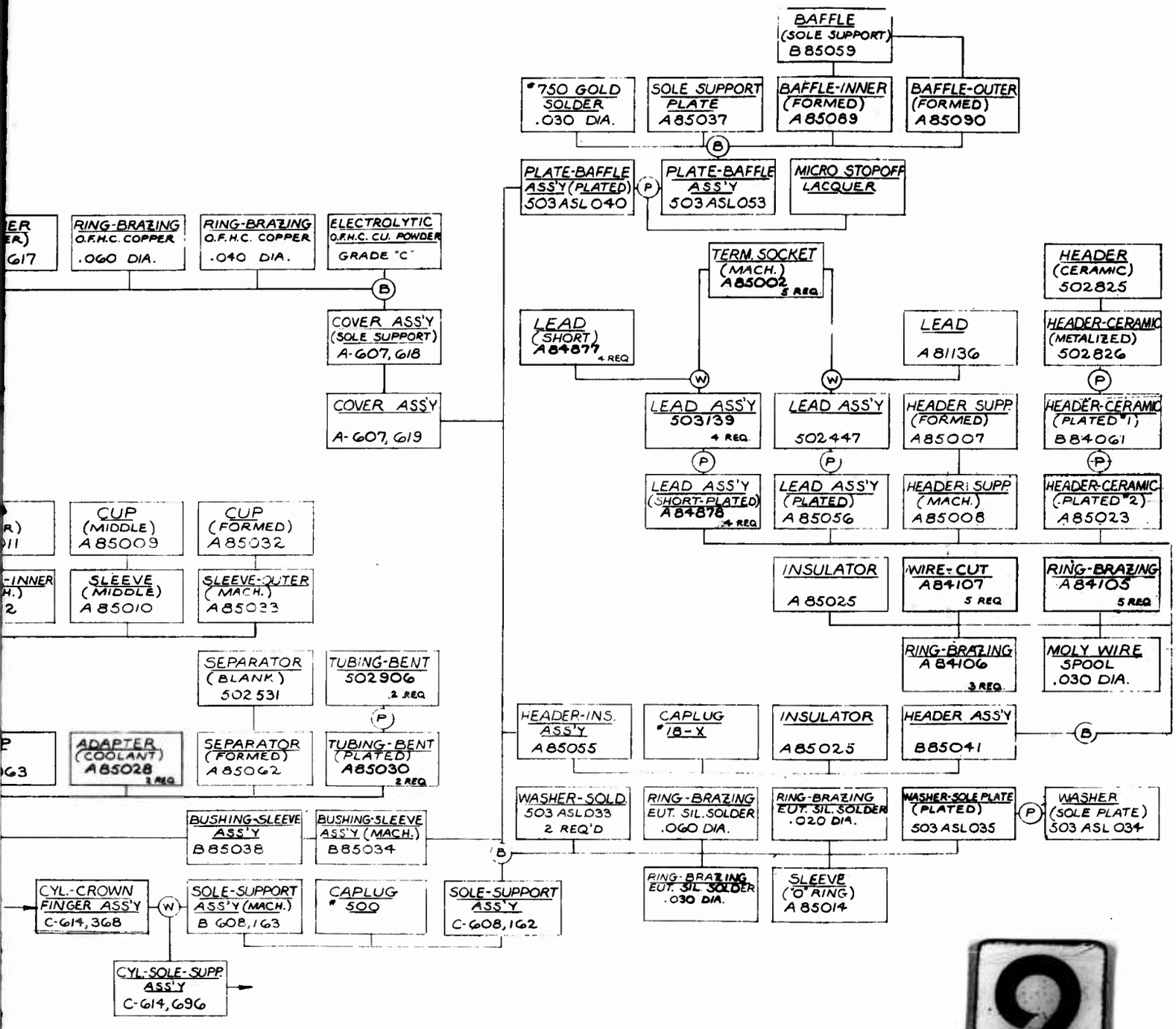
QKA 852

2



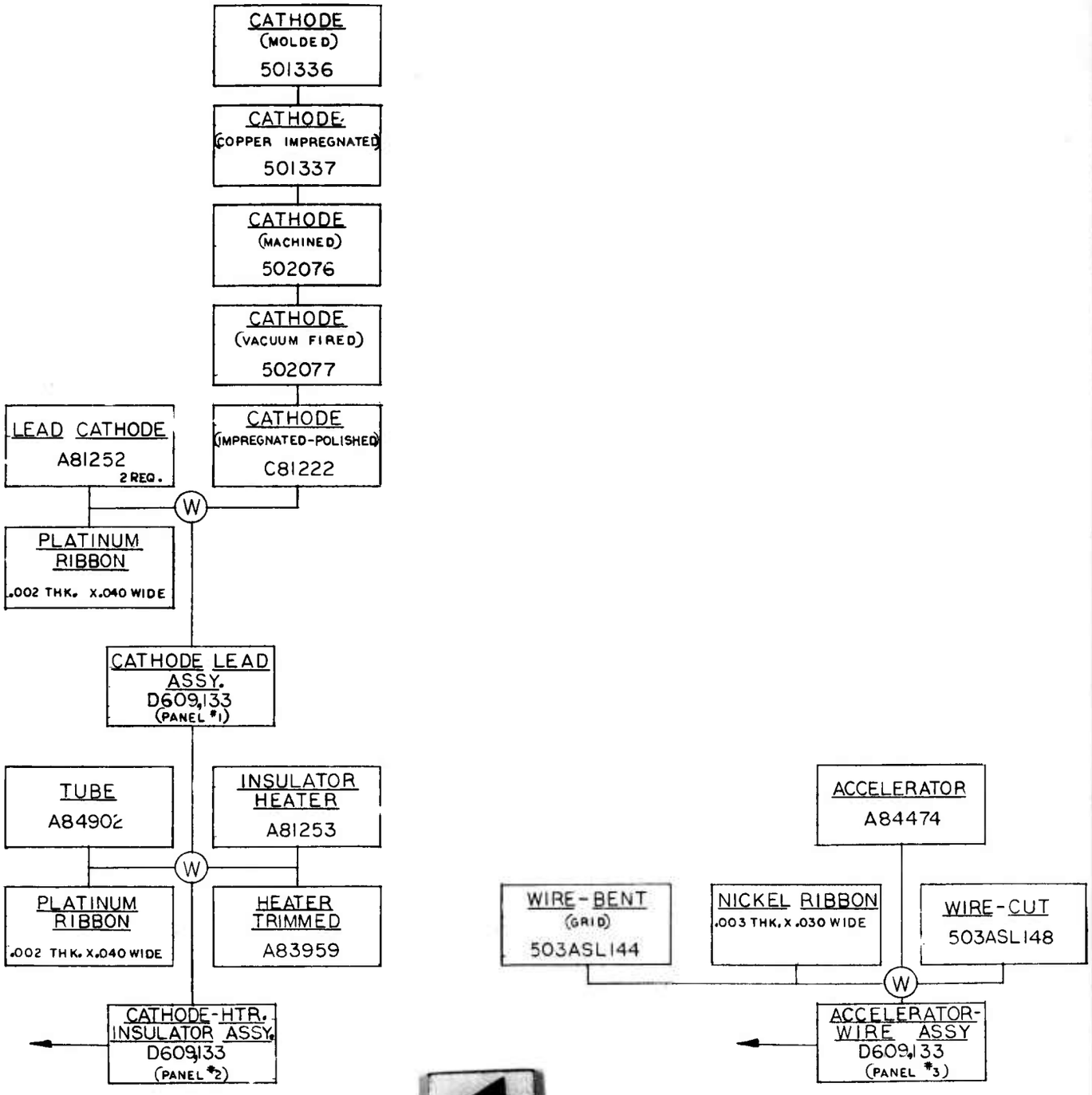
1

FLOW CHART
CYL.-SOLE SUPPORT ASS'Y
QKA852



FLOW CHART
CYL.-SOLE SUPPORT ASS'Y
QKA852

2

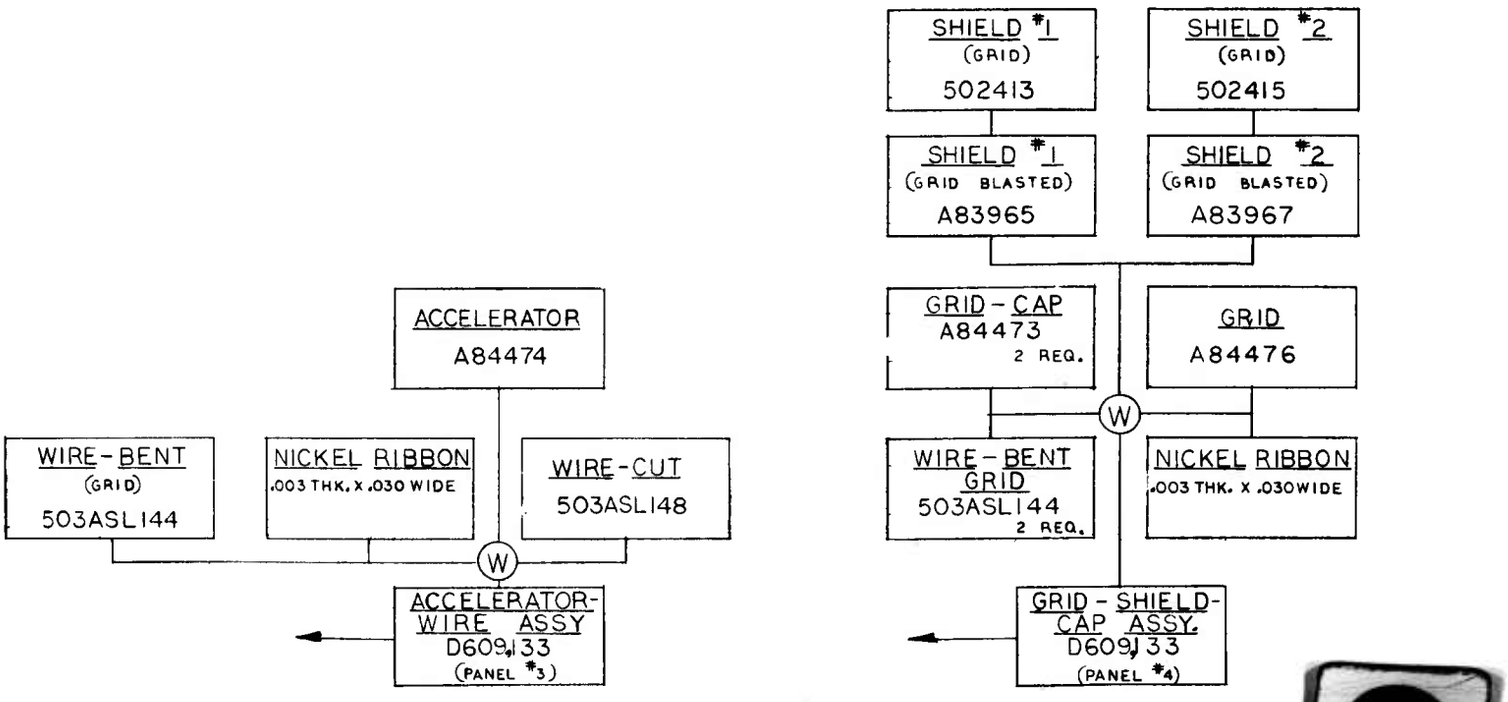


1

FLOW CHART

GUN ASSEMBLY

QKA 852

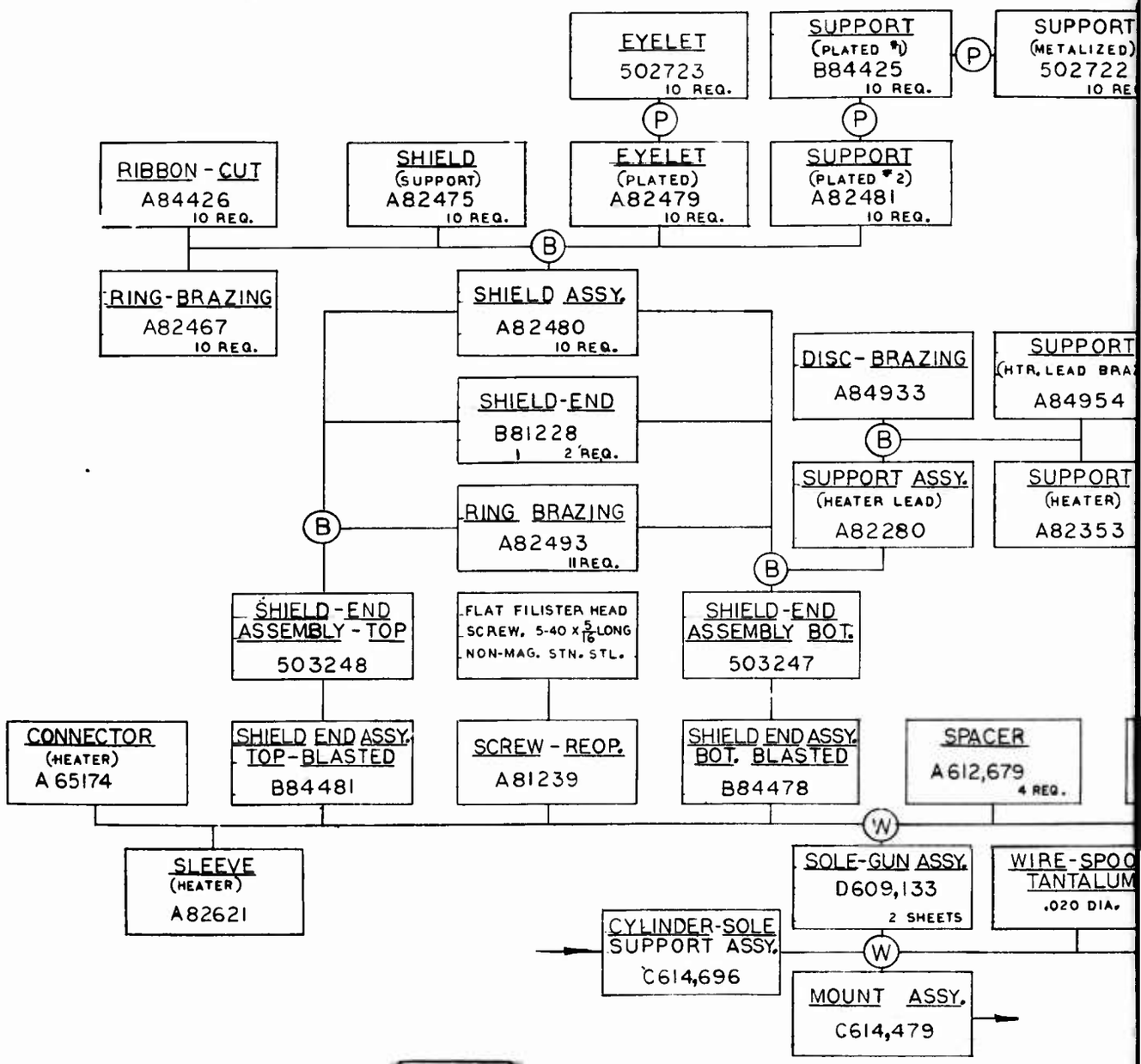


FLOW CHART

GUN ASSEMBLY

QKA 852

2

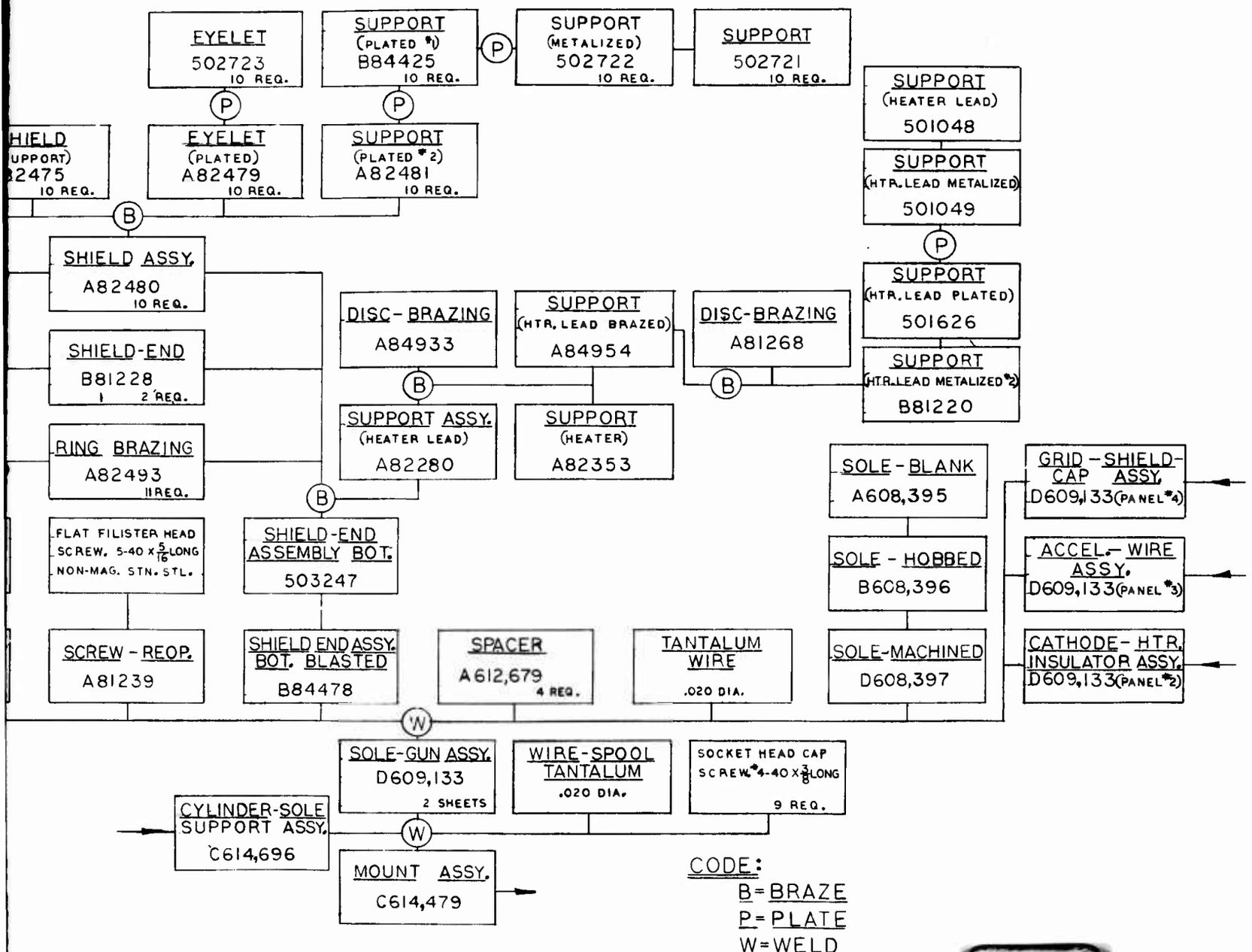


1

FLOW CHART

MOUNT ASSEMBLY

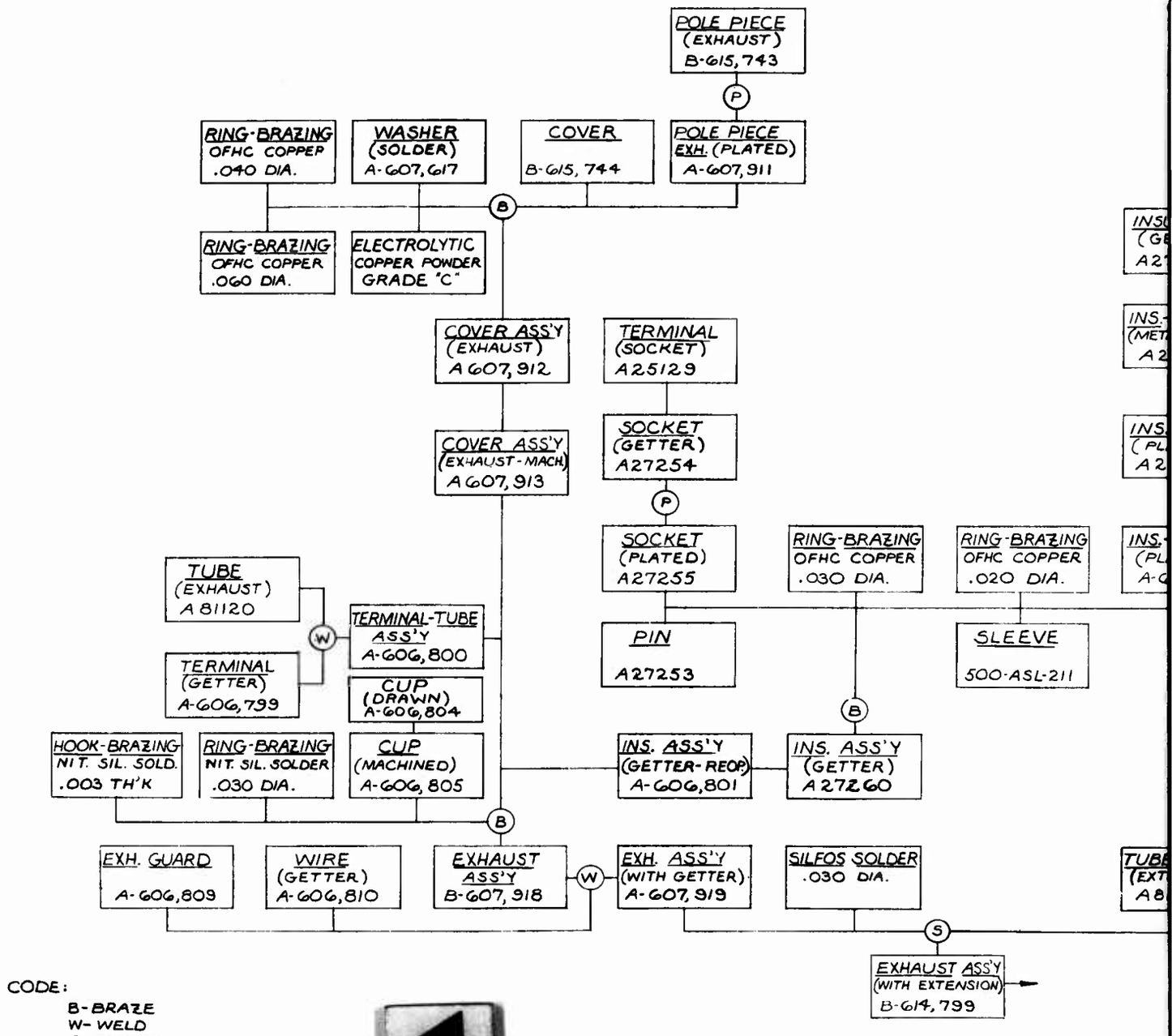
QKA 852



CODE:
B = BRAZE
P = PLATE
W = WELD

FLOW CHART
MOUNT ASSEMBLY
QKA 852

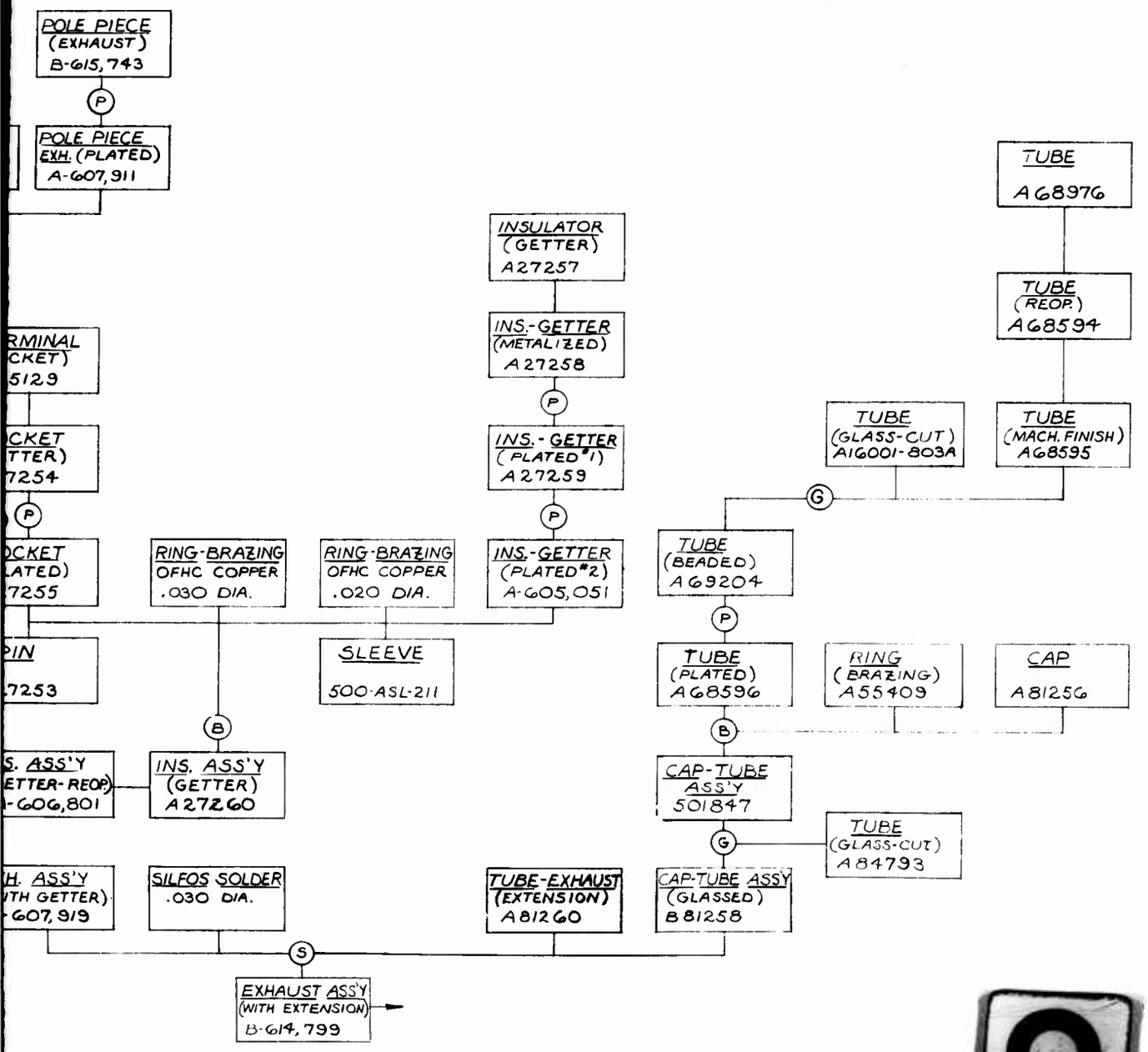
2



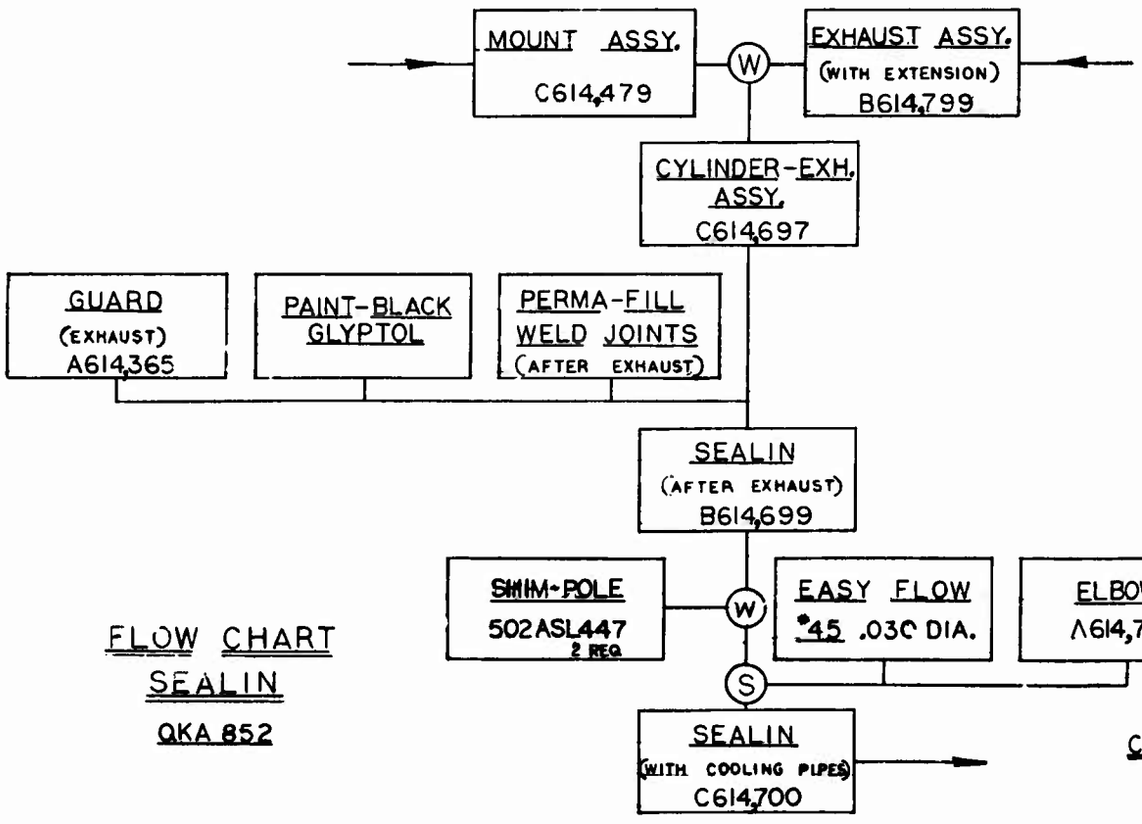
CODE:

B- BRAZE
W- WELD
P- PLATED
G- GLASSED
S- SOLDER

QKA852 FLOW CHART (EXHAUST ASS'Y

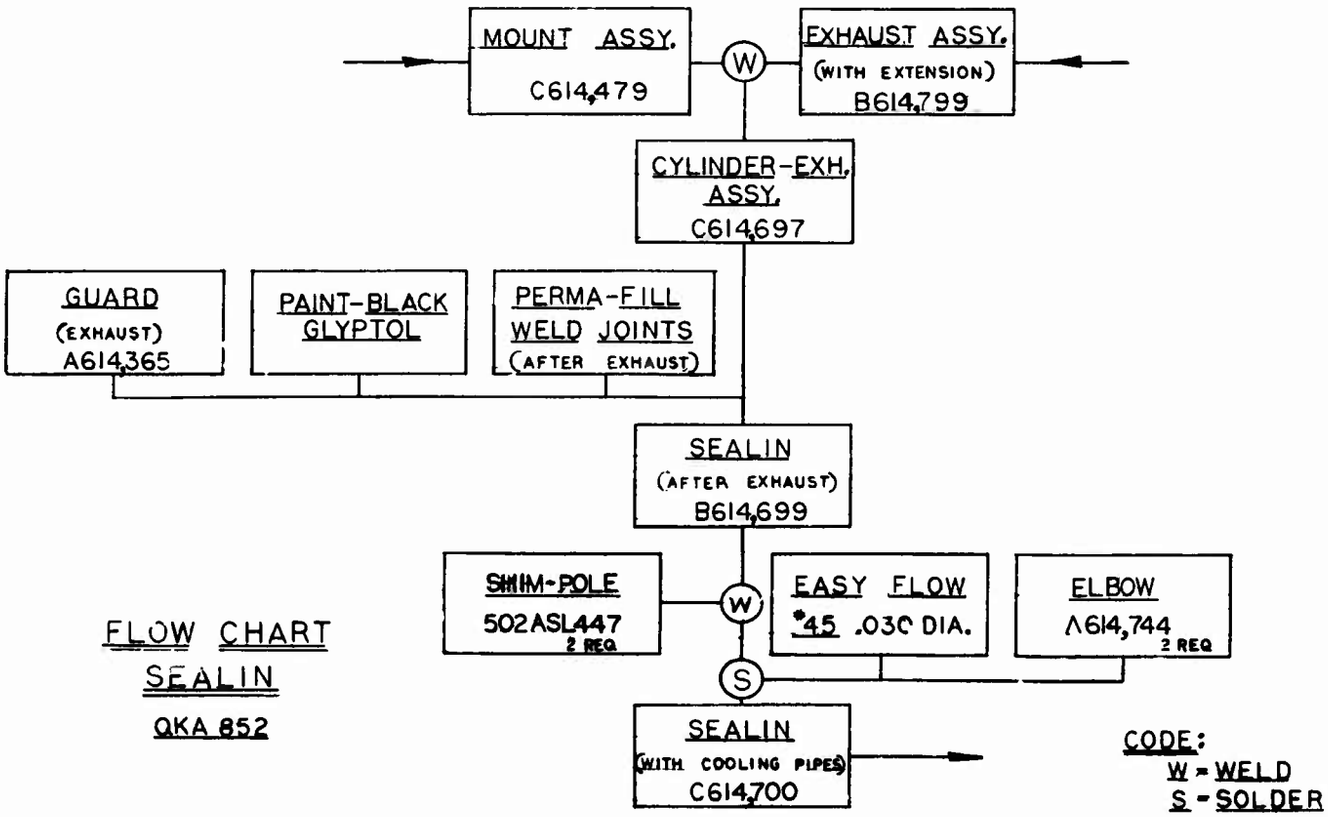


QKA852 FLOW CHART (EXHAUST ASS'Y)



FLOW CHART
SEALIN
QKA 852

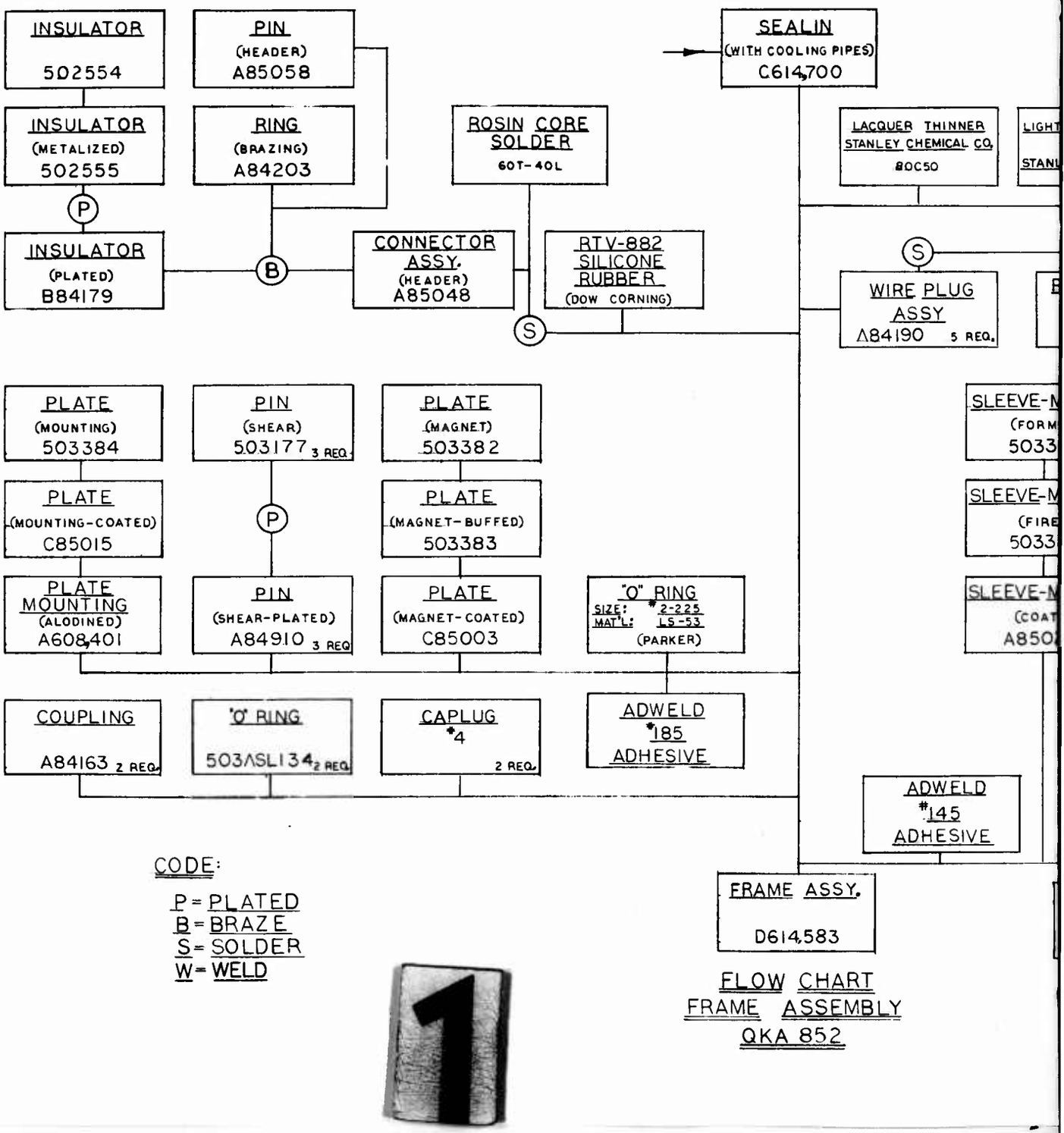
1



FLOW CHART
SEALIN
QKA 852

CODE:
W = WELD
S = SOLDER

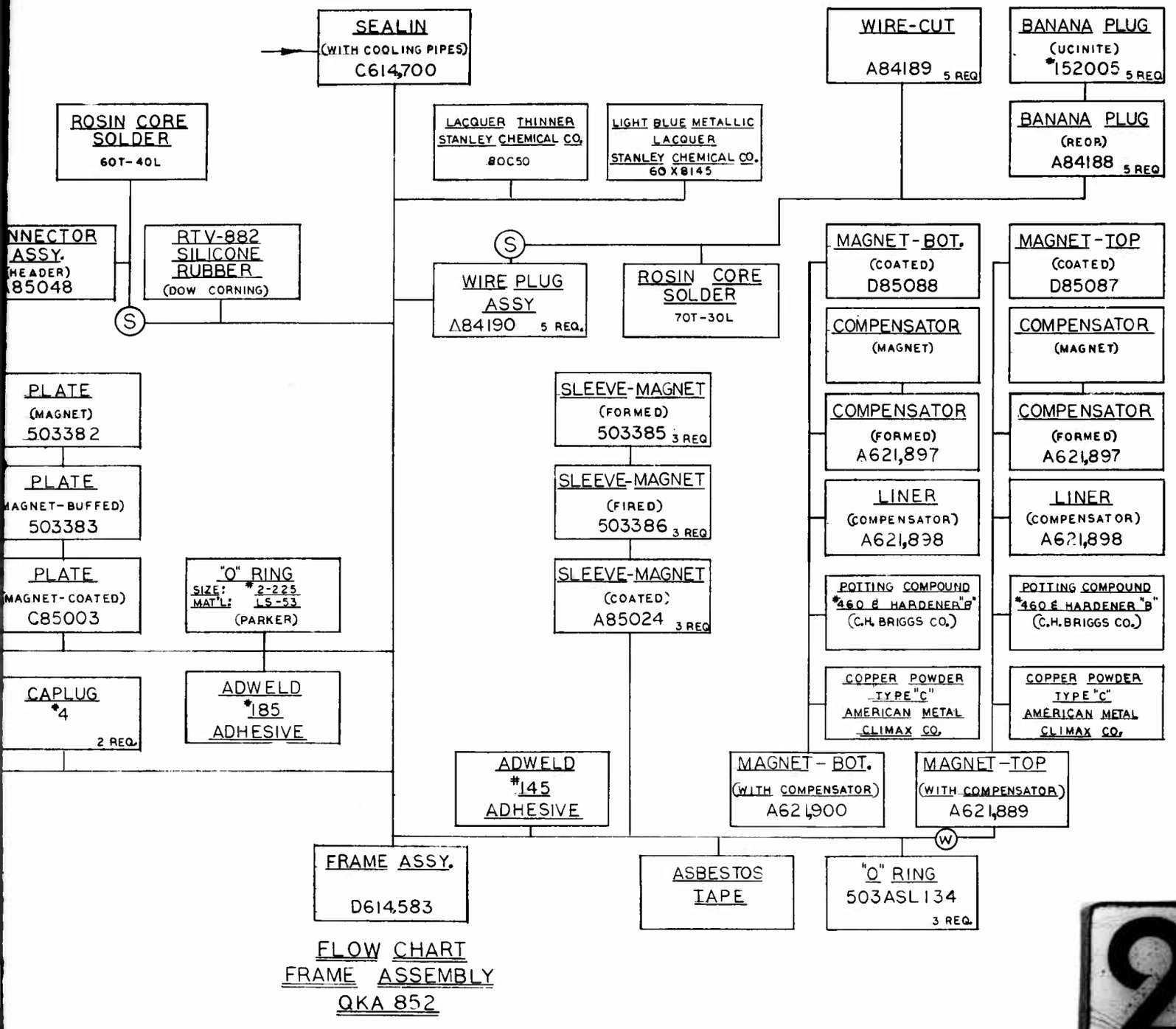
2



CODE:

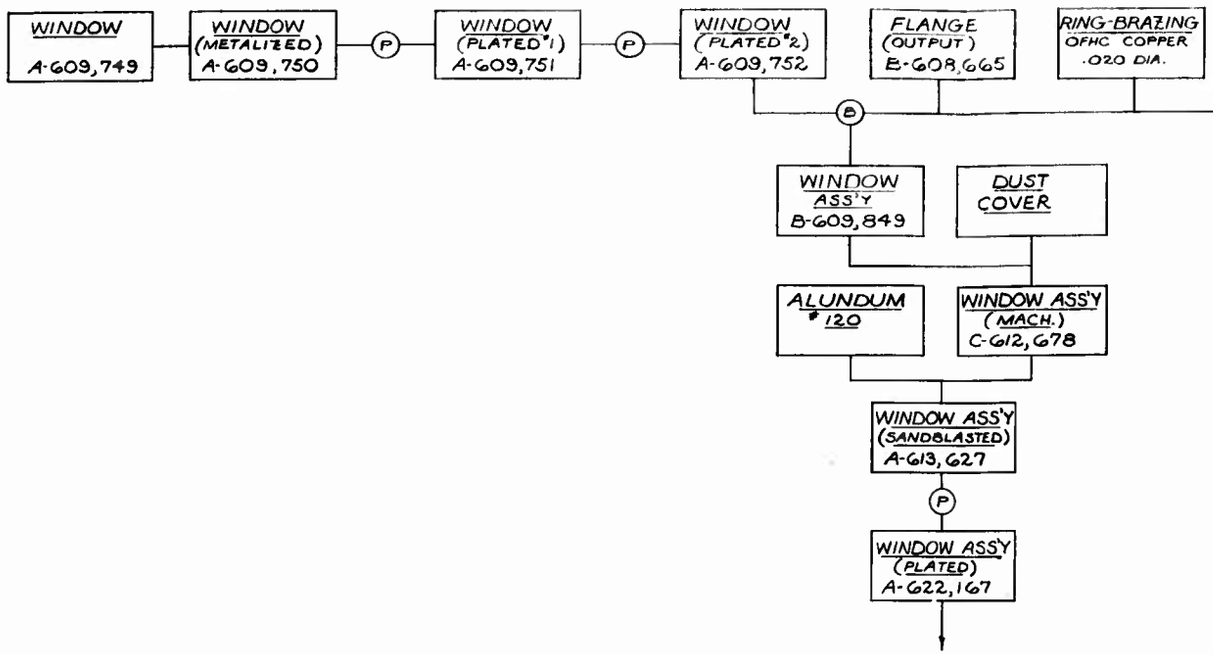
P = PLATED
B = BRAZE
S = SOLDER
W = WELD

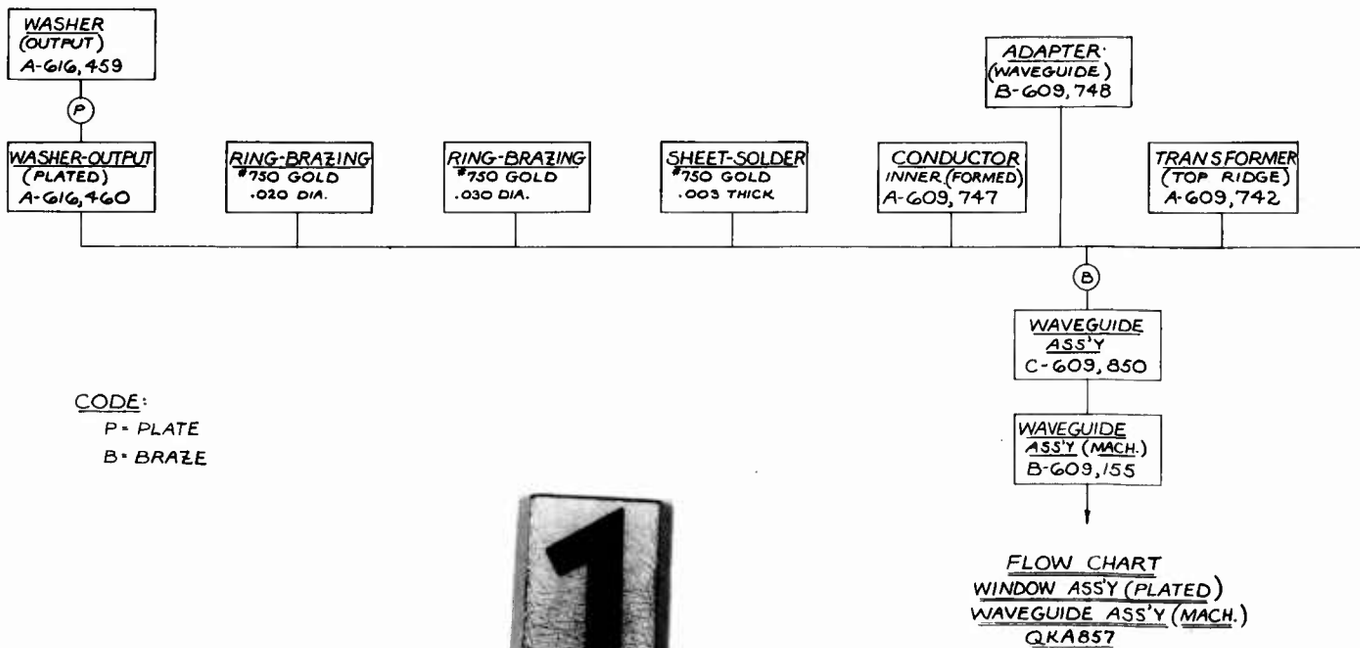
FLOW CHART
FRAME ASSEMBLY
QKA 852



FLOW CHART
FRAME ASSEMBLY
QKA 852

2

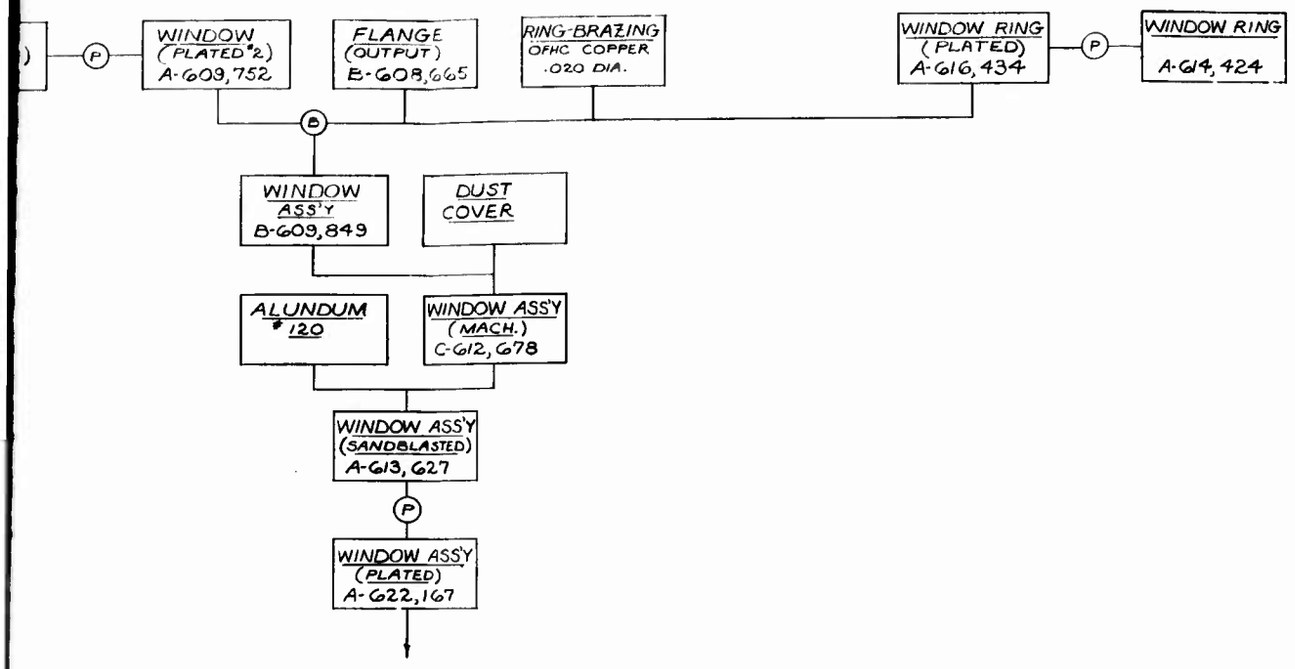


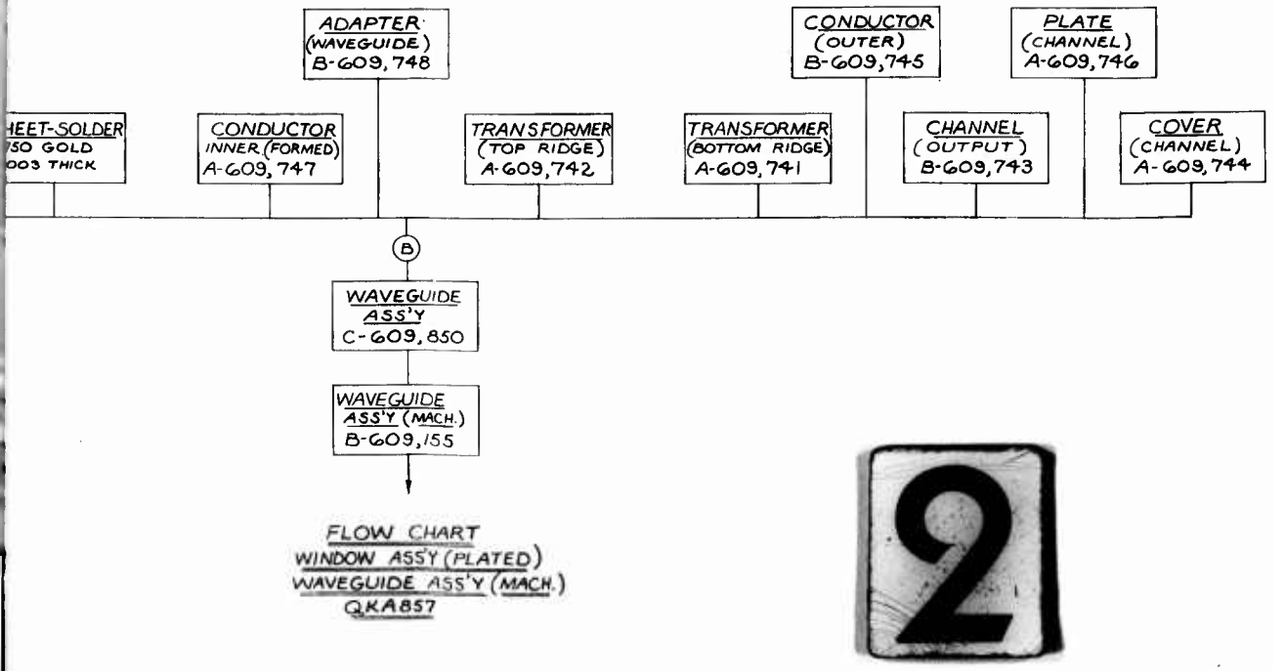


CODE:
P = PLATE
B = BRAZE

1

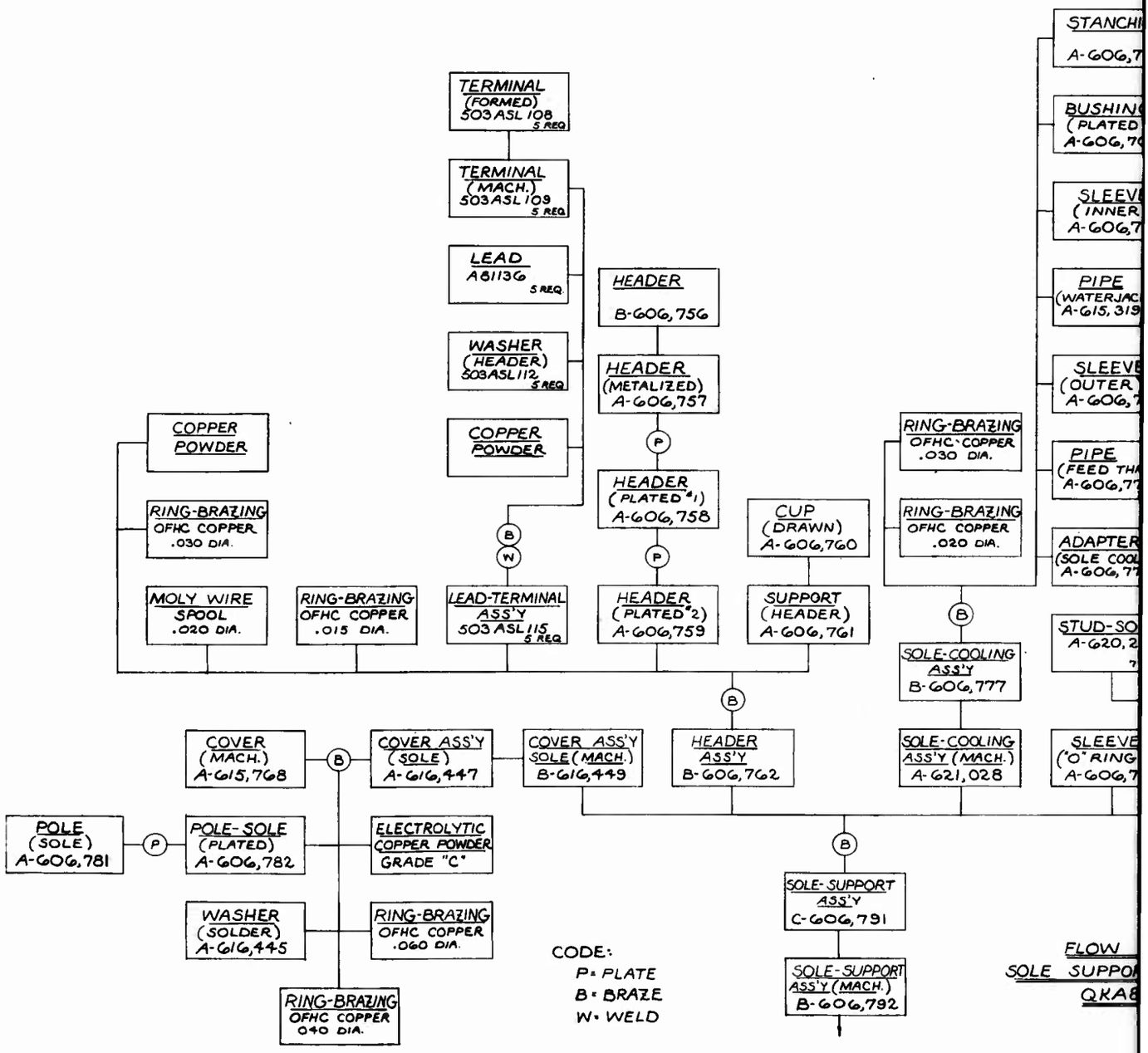
FLOW CHART
WINDOW ASS'Y (PLATED)
WAVEGUIDE ASS'Y (MACH.)
QKA857

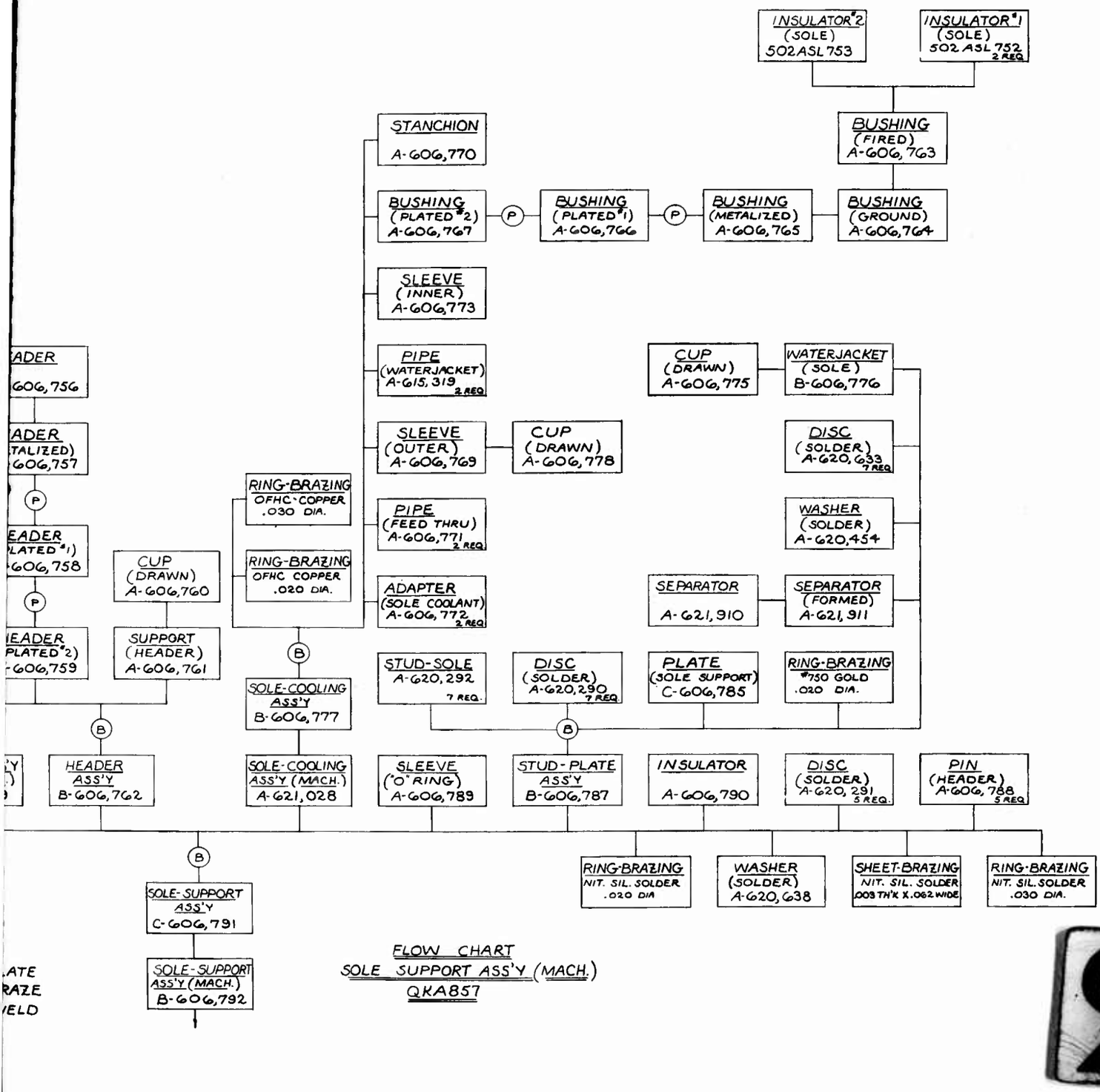




FLOW CHART
WINDOW ASS'Y (PLATED)
WAVEGUIDE ASS'Y (MACH.)
QKA857

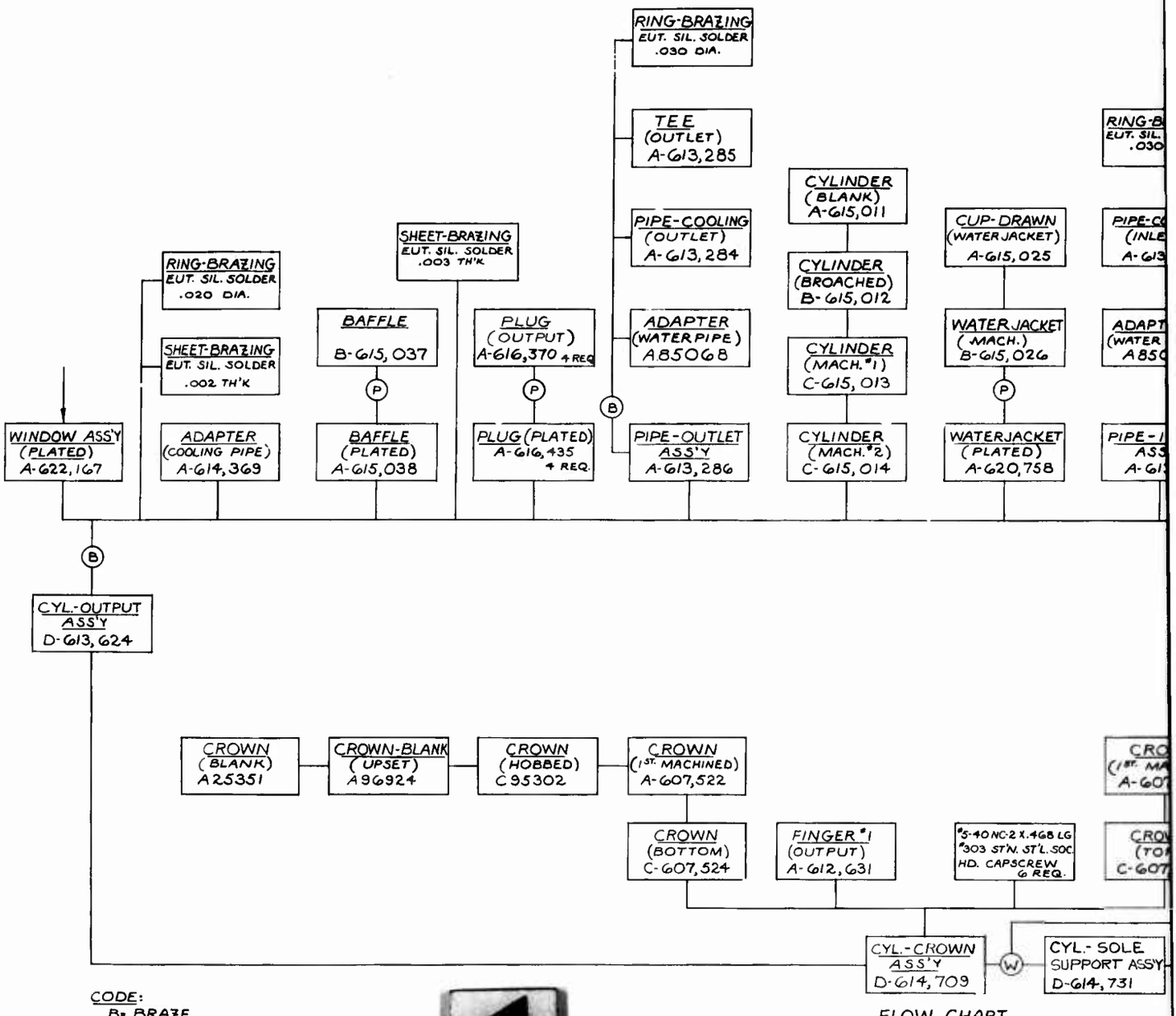
2


TERMINAL (FORMED) 503ASL108 5 REQ
TERMINAL (MACH.) 503ASL109 5 REQ
LEAD A61136 5 REQ
WASHER (HEADER) 503ASL112 5 REQ
COPPER POWDER
HEADER B-606,756
HEADER (METALIZED) A-606,757
HEADER (PLATED #1) A-606,758
HEADER (PLATED #2) A-606,759
COPPER POWDER
RING-BRAZING OFHC COPPER .030 DIA.
MOLY WIRE SPOOL .020 DIA.
RING-BRAZING OFHC COPPER .015 DIA.
LEAD-TERMINAL ASS'Y 503ASL115 5 REQ
CUP (DRAWN) A-606,760
SUPPORT (HEADER) A-606,761
RING-BRAZING OFHC COPPER .030 DIA.
RING-BRAZING OFHC COPPER .020 DIA.
SOLE-COOLING ASS'Y B-606,777
SOLE-COOLING ASS'Y (MACH.) A-621,028
COVER (MACH.) A-615,768
COVER ASS'Y (SOLE) A-616,447
COVER ASS'Y SOLE (MACH.) B-616,449
HEADER ASS'Y B-606,762
POLE (SOLE) A-606,781
POLE-SOLE (PLATED) A-606,782
ELECTROLYTIC COPPER POWDER GRADE "C"
WASHER (SOLDER) A-616,445
RING-BRAZING OFHC COPPER .060 DIA.
RING-BRAZING OFHC COPPER 040 DIA.
SOLE-SUPPORT ASS'Y C-606,791
SOLE-SUPPORT ASS'Y (MACH.) B-606,792
CODE:
P = PLATE
B = BRAZE
W = WELD
STANCHI A-606,7
BUSHIN (PLATED A-606,7
SLEEVE (INNER A-606,7
PIPE (WATERJAC A-615,319
SLEEVE (OUTER A-606,7
PIPE (FEED TH A-606,7
ADAPTER (SOLE COOL A-606,7
STUD-SO A-620,2
SLEEVE ("O" RING A-606,7
FLOW
SOLE SUPPO
QKA8



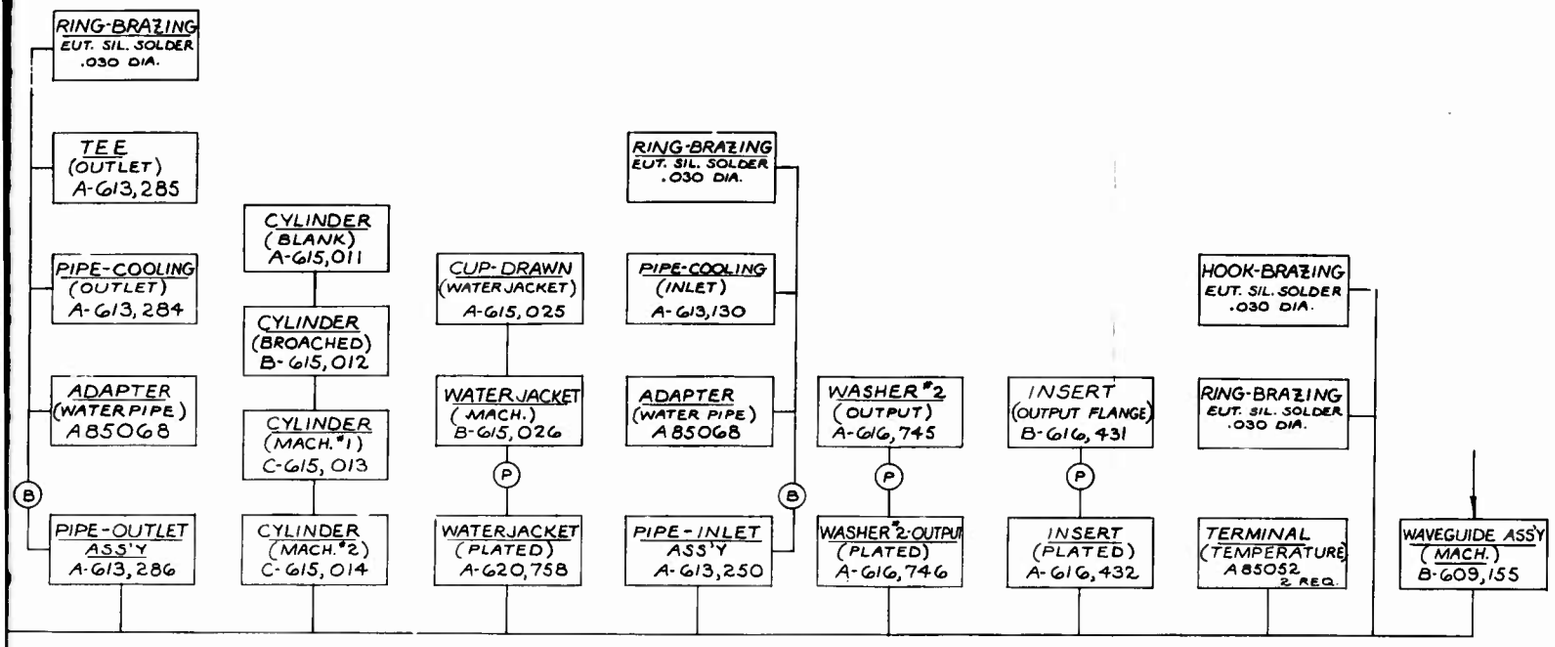
FLOW CHART
SOLE SUPPORT ASS'Y (MACH.)
QKA857

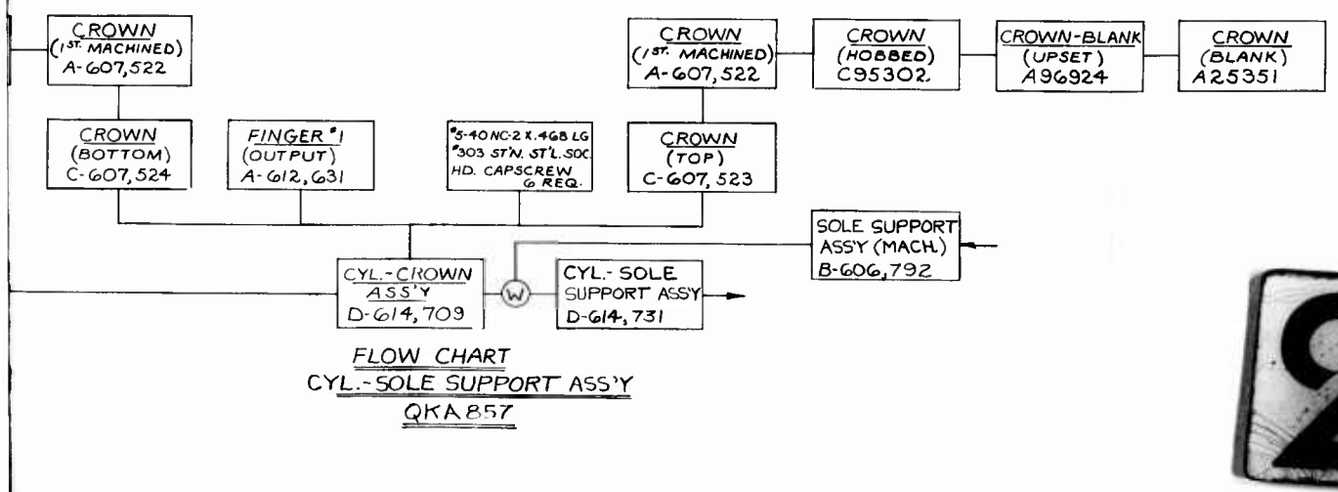
2



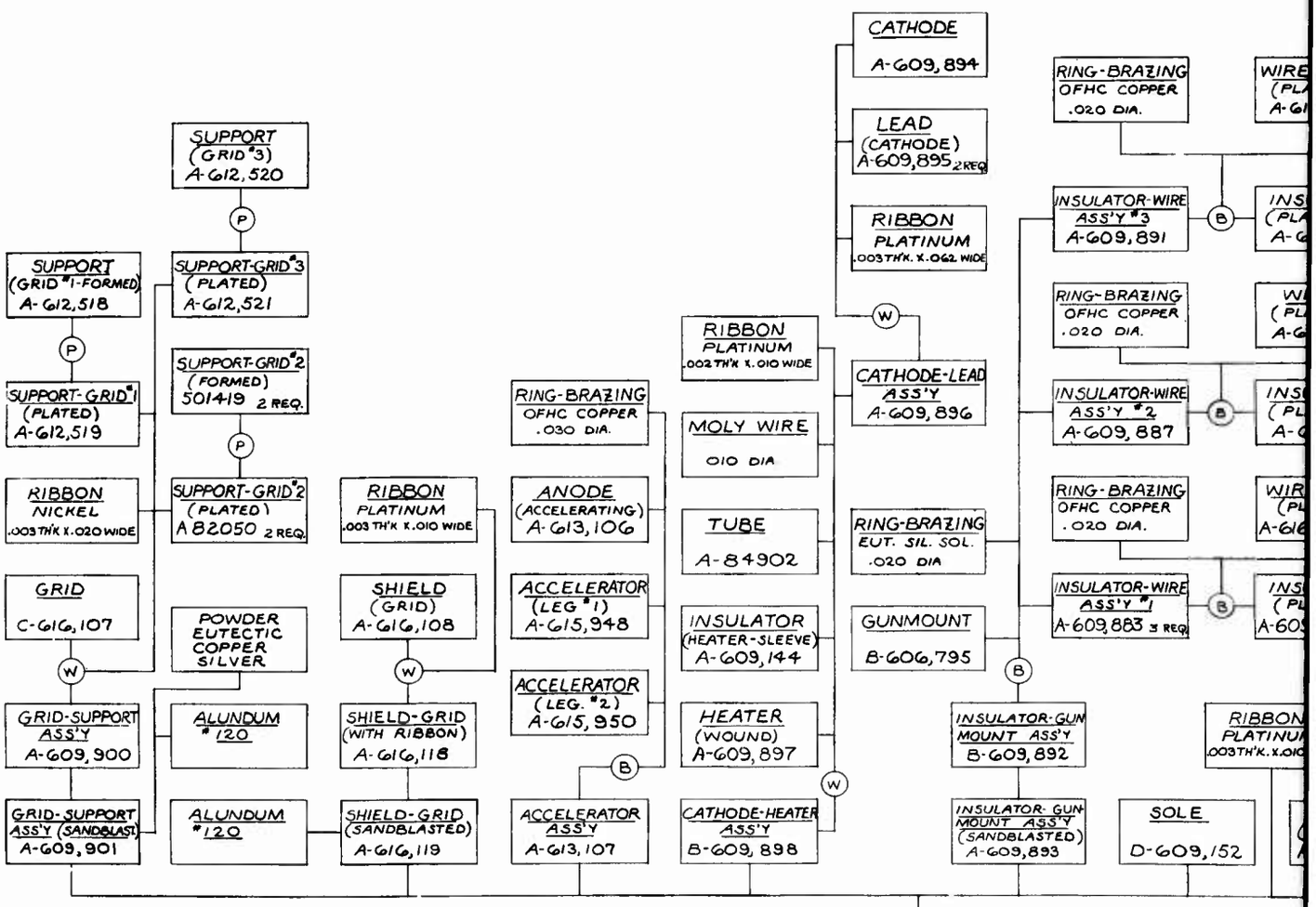
CODE:
B= BRAZE
P= PLATE

FLOW CHART
CYL.-SOLE SUPPORT ASS'Y
QKA 857





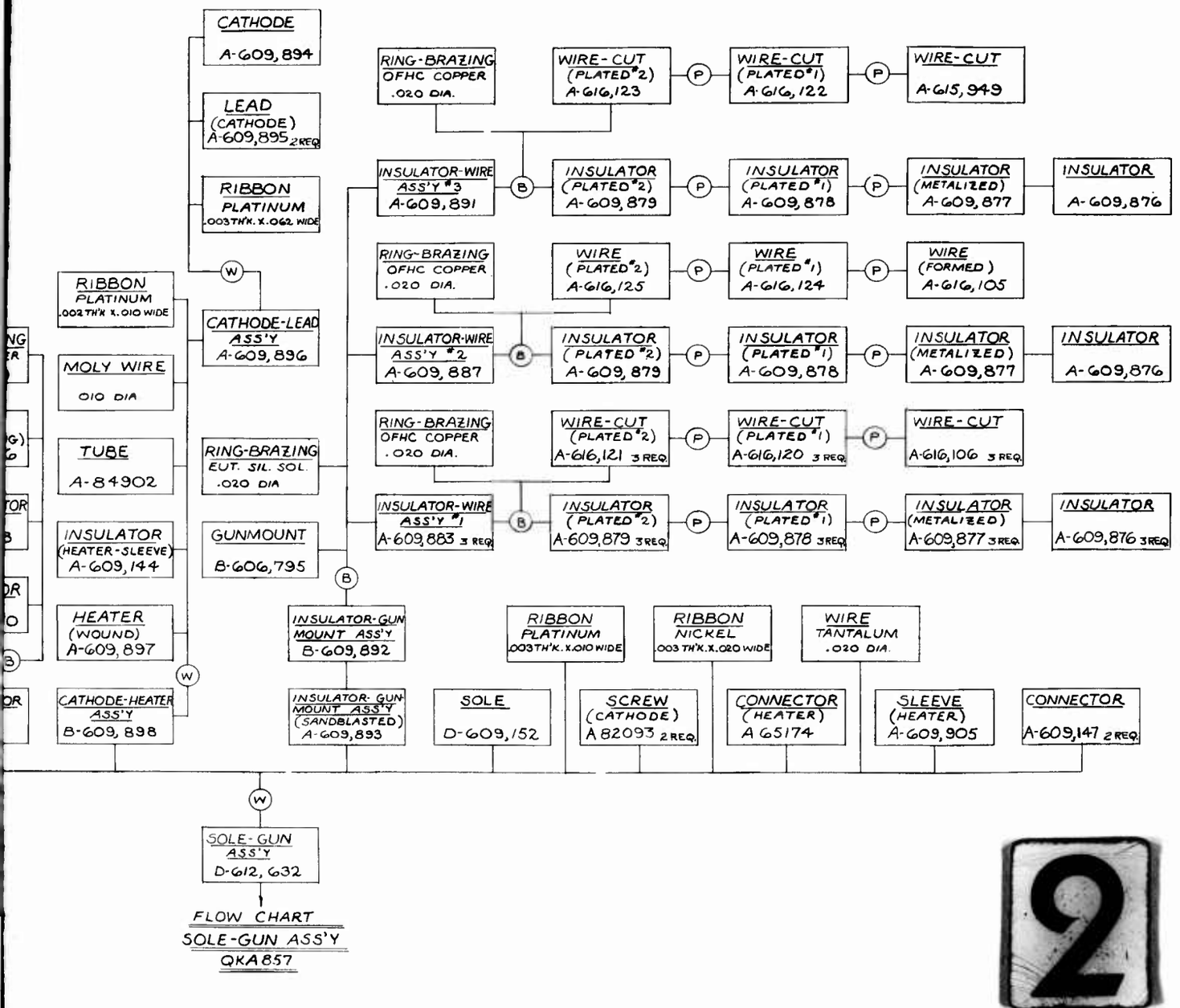
FLOW CHART
CYL.-SOLE SUPPORT ASS'Y
QKA857

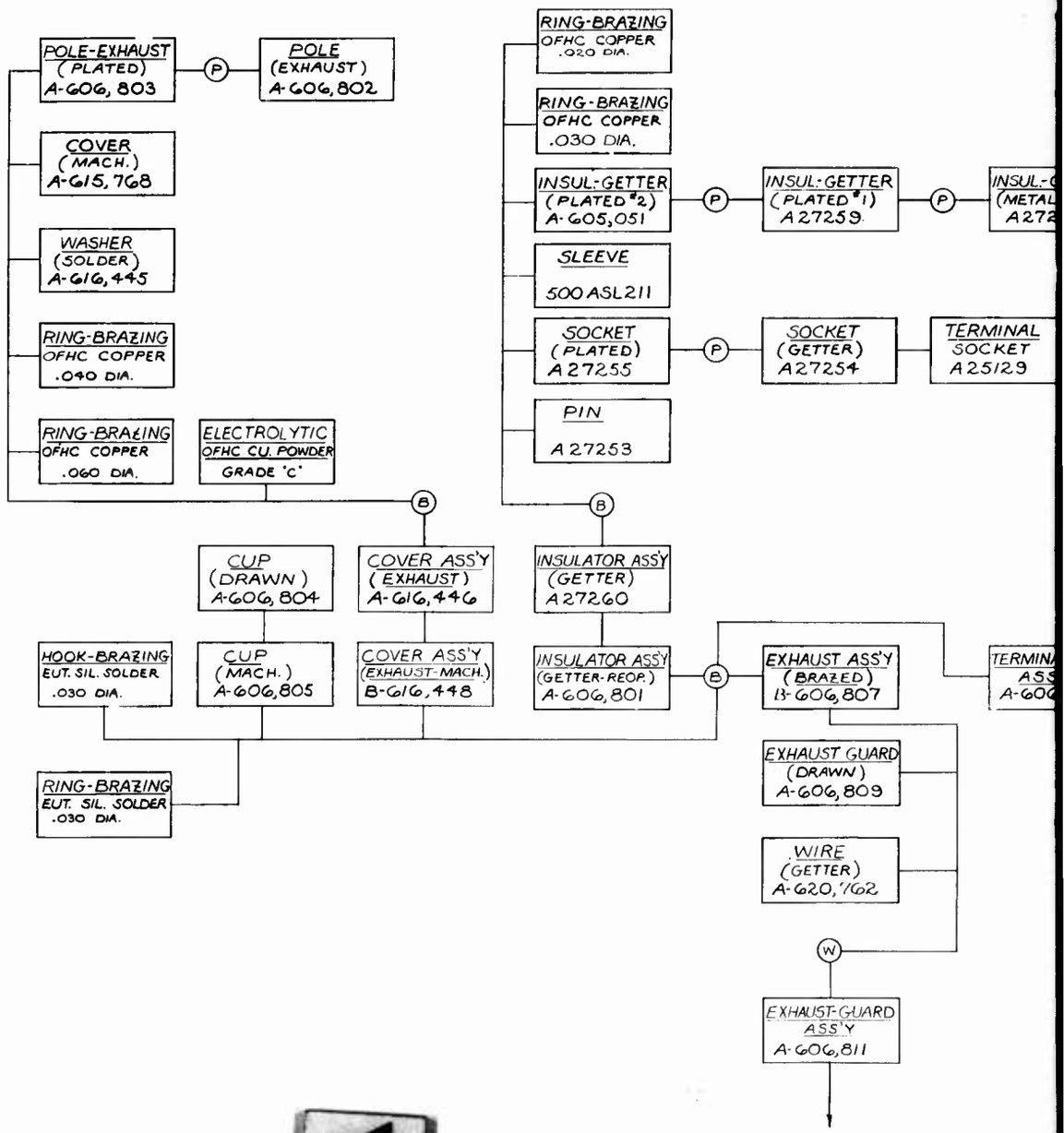


CODE:

B - BRAZE
P - PLATE
W - WELD

FLOW CHART
SOLE-GUN ASS'Y
QKA857

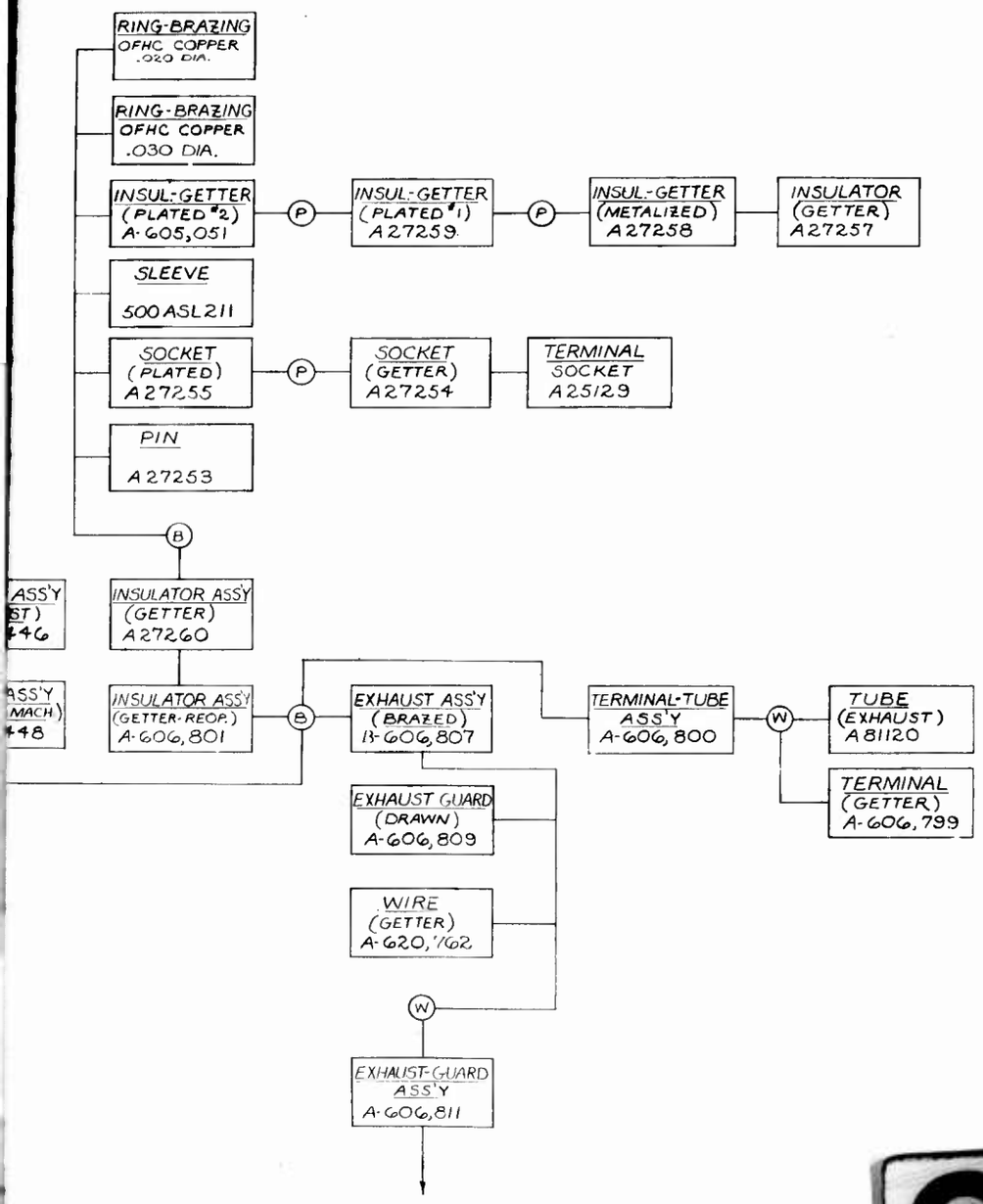

CATHODE
A-609,894
LEAD
(CATHODE)
A-609,895 2 REQ.
RIBBON
PLATINUM
.003 TH'K. X .062 WIDE
RIBBON
PLATINUM
.002 TH'K X .010 WIDE
CATHODE-LEAD
ASS'Y
A-609,896
MOLY WIRE
.010 DIA
TUBE
A-84902
RING-BRAZING
EUT. SIL. SOL.
.020 DIA
INSULATOR
(HEATER-SLEEVE)
A-609,144
GUNMOUNT
B-606,795
HEATER
(WOUND)
A-609,897
CATHODE-HEATER
ASS'Y
B-609,898
RING-BRAZING
OFHC COPPER
.020 DIA.
WIRE-CUT
(PLATED #2)
A-616,123
WIRE-CUT
(PLATED #1)
A-616,122
WIRE-CUT
A-615,949
INSULATOR-WIRE
ASS'Y #3
A-609,891
INSULATOR
(PLATED #2)
A-609,879
INSULATOR
(PLATED #1)
A-609,878
INSULATOR
(METALIZED)
A-609,877
INSULATOR
A-609,876
RING-BRAZING
OFHC COPPER
.020 DIA.
WIRE
(PLATED #2)
A-616,125
WIRE
(PLATED #1)
A-616,124
WIRE
(FORMED)
A-616,105
INSULATOR-WIRE
ASS'Y #2
A-609,887
INSULATOR
(PLATED #2)
A-609,879
INSULATOR
(PLATED #1)
A-609,878
INSULATOR
(METALIZED)
A-609,877
INSULATOR
A-609,876
RING-BRAZING
OFHC COPPER
.020 DIA.
WIRE-CUT
(PLATED #2)
A-616,121 3 REQ.
WIRE-CUT
(PLATED #1)
A-616,120 3 REQ.
WIRE-CUT
A-616,106 3 REQ.
INSULATOR-WIRE
ASS'Y #1
A-609,883 3 REQ.
INSULATOR
(PLATED #2)
A-609,879 3 REQ.
INSULATOR
(PLATED #1)
A-609,878 3 REQ.
INSULATOR
(METALIZED)
A-609,877 3 REQ.
INSULATOR
A-609,876 3 REQ.
INSULATOR-GUN
MOUNT ASS'Y
B-609,892
RIBBON
PLATINUM
.003 TH'K. X .010 WIDE
RIBBON
NICKEL
.003 TH'K. X .020 WIDE
WIRE
TANTALUM
.020 DIA.
INSULATOR-GUN
MOUNT ASS'Y
(SANDBLASTED)
A-609,893
SOLE
D-609,152
SCREW
(CATHODE)
A 82093 2 REQ.
CONNECTOR
(HEATER)
A 65174
SLEEVE
(HEATER)
A-609,905
CONNECTOR
A-609,147 2 REQ.
SOLE-GUN
ASS'Y
D-612,632
FLOW CHART
SOLE-GUN ASS'Y
QKA 857
2



CODE:

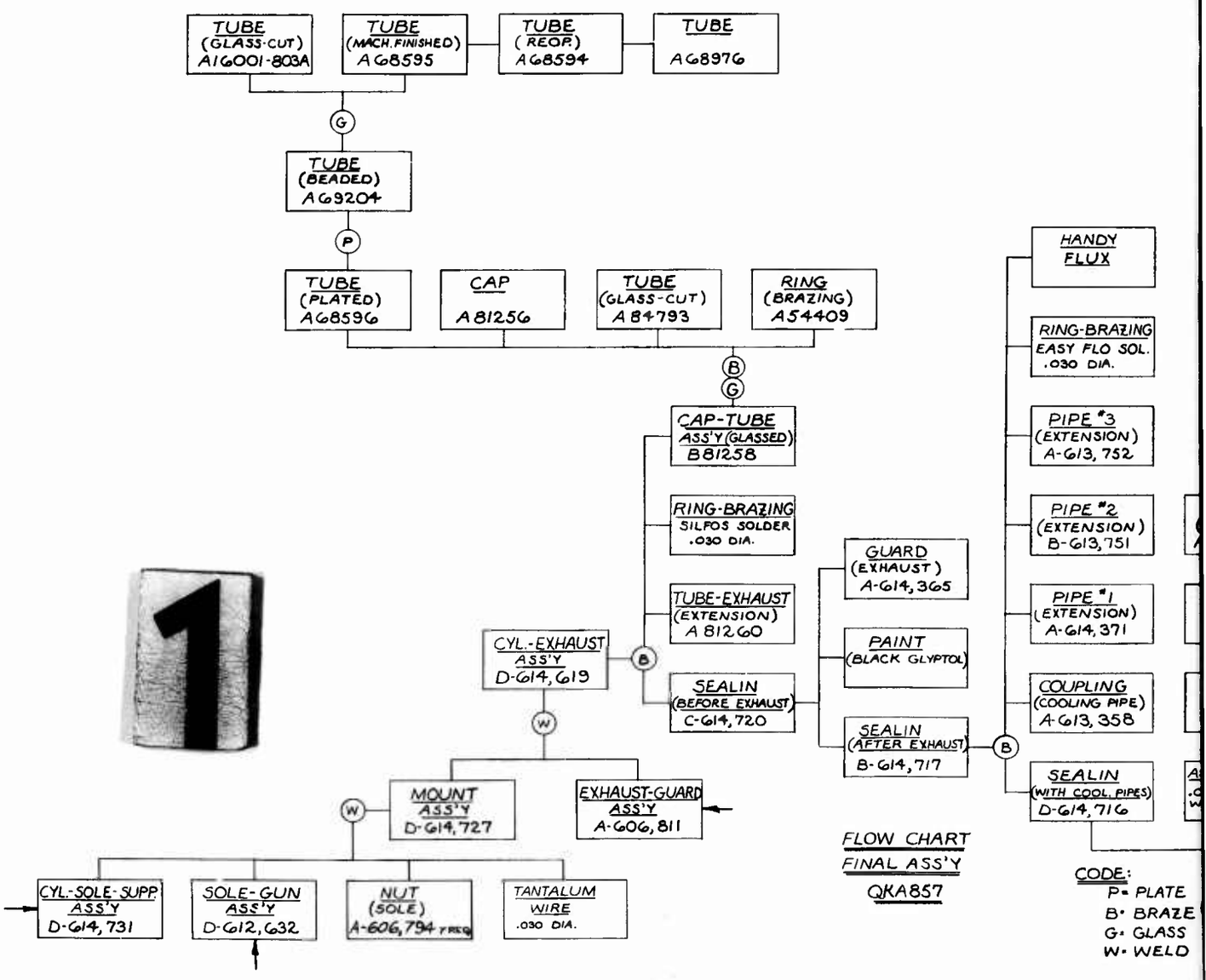
B- BRAZE
W- WELD
P- PLATE

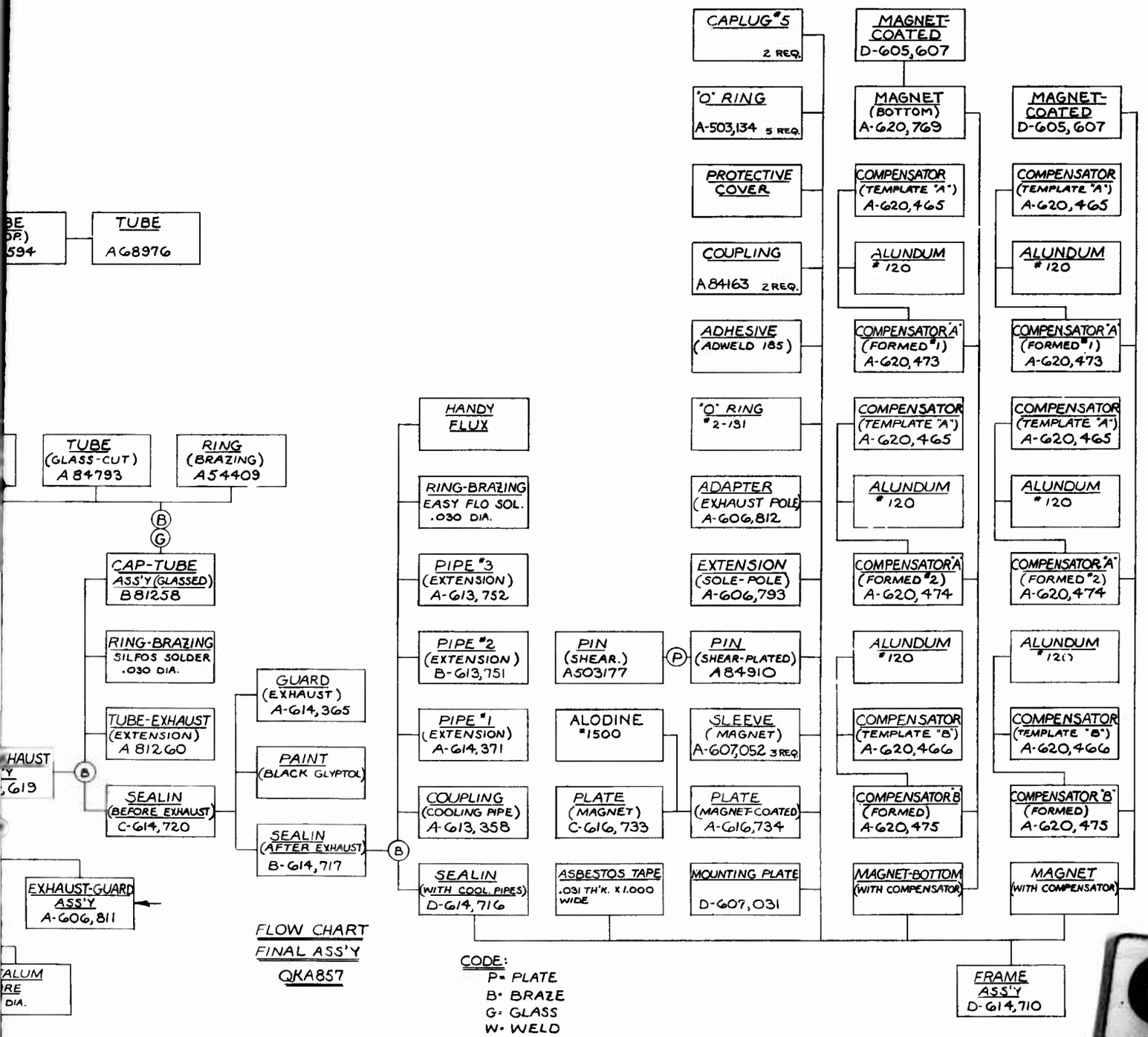
FLOW CHART
EXHAUST-GUARD ASS'Y
QKA857



FLOW CHART
EXHAUST-GUARD ASS'Y
QKA857

2

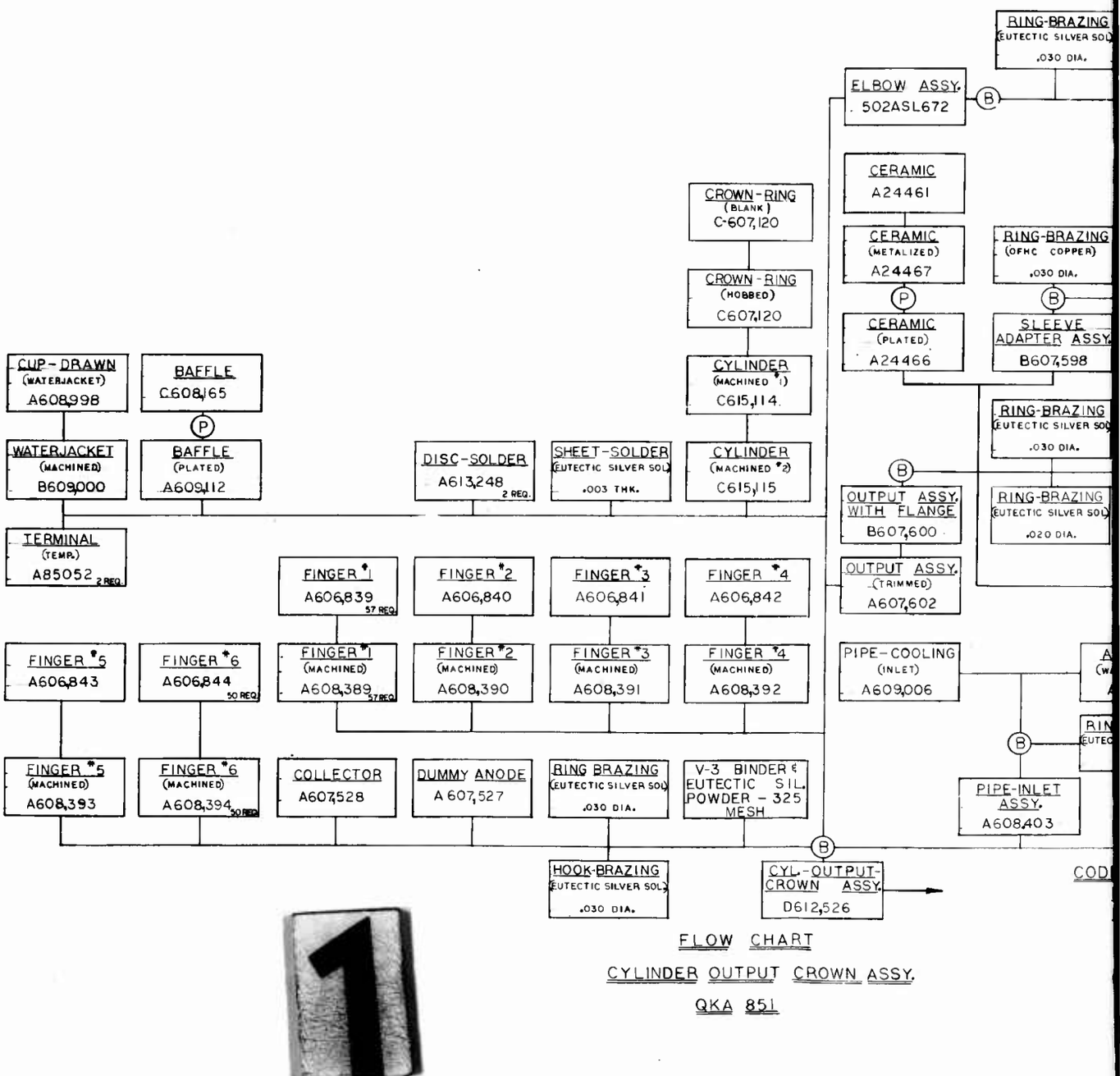

TUBE (GLASS-CUT) A16001-803A
TUBE (MACH. FINISHED) A68595
TUBE (REOR.) A68594
TUBE A68976
G
TUBE (BEADED) A69204
P
TUBE (PLATED) A68596
CAP A81256
TUBE (GLASS-CUT) A84793
RING (BRAZING) A54409
B
G
CAP-TUBE ASS'Y (GLASSED) B81258
RING-BRAZING SILFOS SOLDER .030 DIA.
TUBE-EXHAUST (EXTENSION) A81260
CYL.-EXHAUST ASS'Y D-614,619
B
SEALIN (BEFORE EXHAUST) C-614,720
W
MOUNT ASS'Y D-614,727
EXHAUST-GUARD ASS'Y A-606,811
W
CYL.-SOLE-SUPP. ASS'Y D-614,731
SOLE-GUN ASS'Y D-612,632
NUT (SOLE) A-606,794 4 REQ
TANTALUM WIRE .030 DIA.
GUARD (EXHAUST) A-614,365
PAINT (BLACK GLYPTOL)
SEALIN (AFTER EXHAUST) B-614,717
B
HANDY FLUX
RING-BRAZING EASY FLO SOL. .030 DIA.
PIPE #3 (EXTENSION) A-613,752
PIPE #2 (EXTENSION) B-613,751
PIPE #1 (EXTENSION) A-614,371
COUPLING (COOLING PIPE) A-613,358
SEALIN (WITH COOL. PIPES) D-614,716
FLOW CHART
FINAL ASS'Y
QKA857
CODE:
P- PLATE
B- BRAZE
G- GLASS
W- WELD



FLOW CHART
FINAL ASS'Y
QKA857

CODE:
P = PLATE
B = BRAZE
G = GLASS
W = WELD

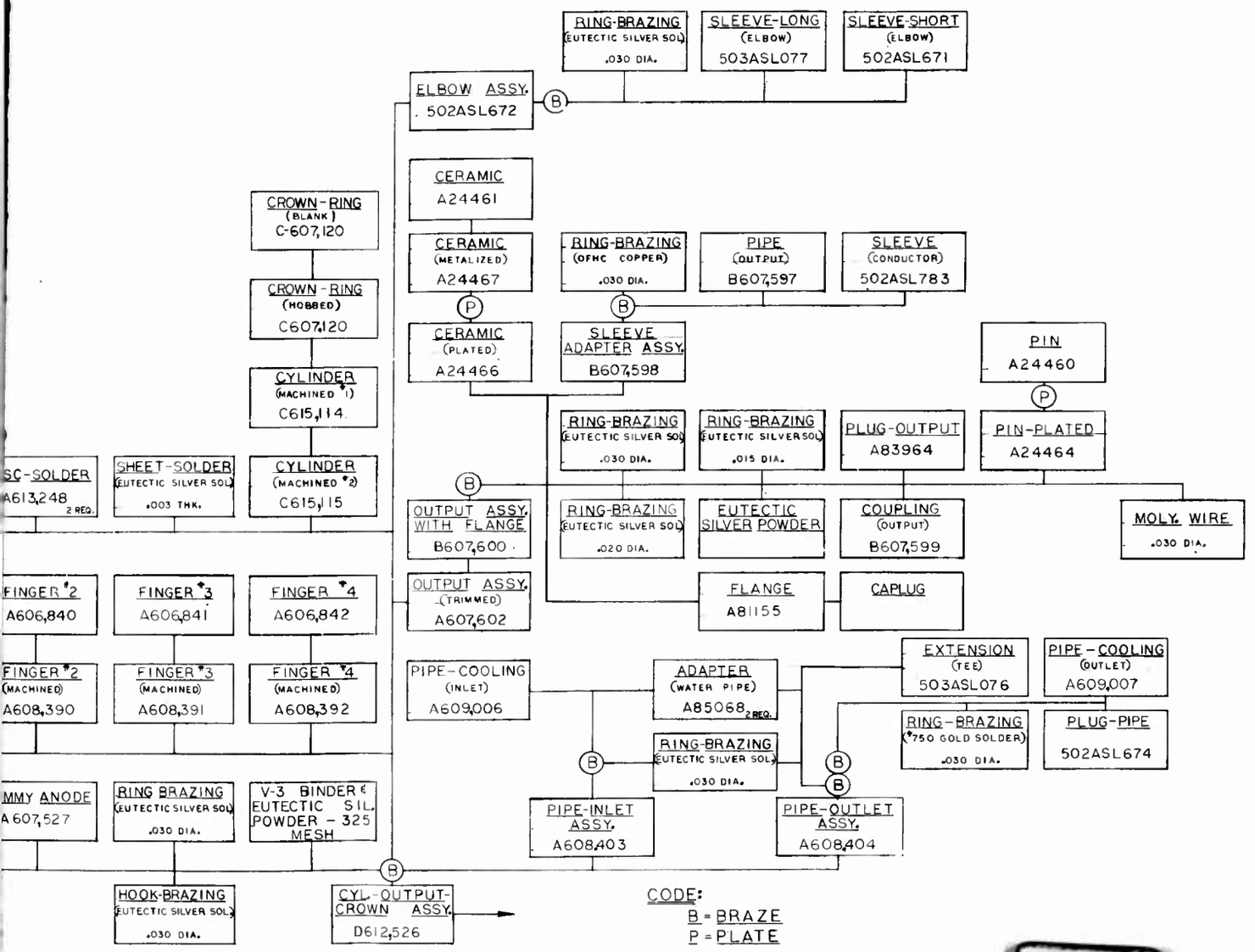
2



FLOW CHART

CYLINDER OUTPUT CROWN ASSY.

QKA 851

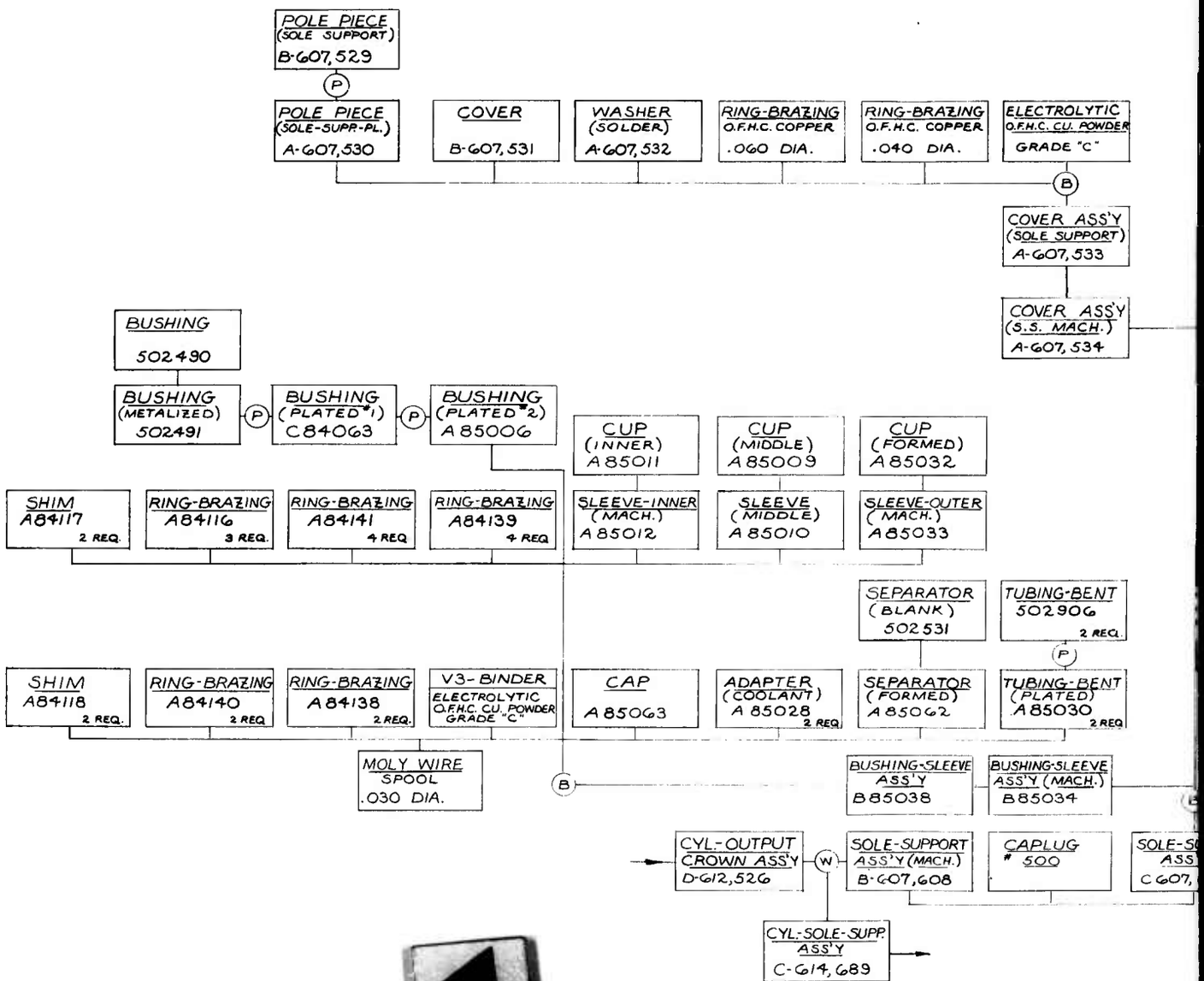


FLOW CHART

CYLINDER OUTPUT CROWN ASSY.

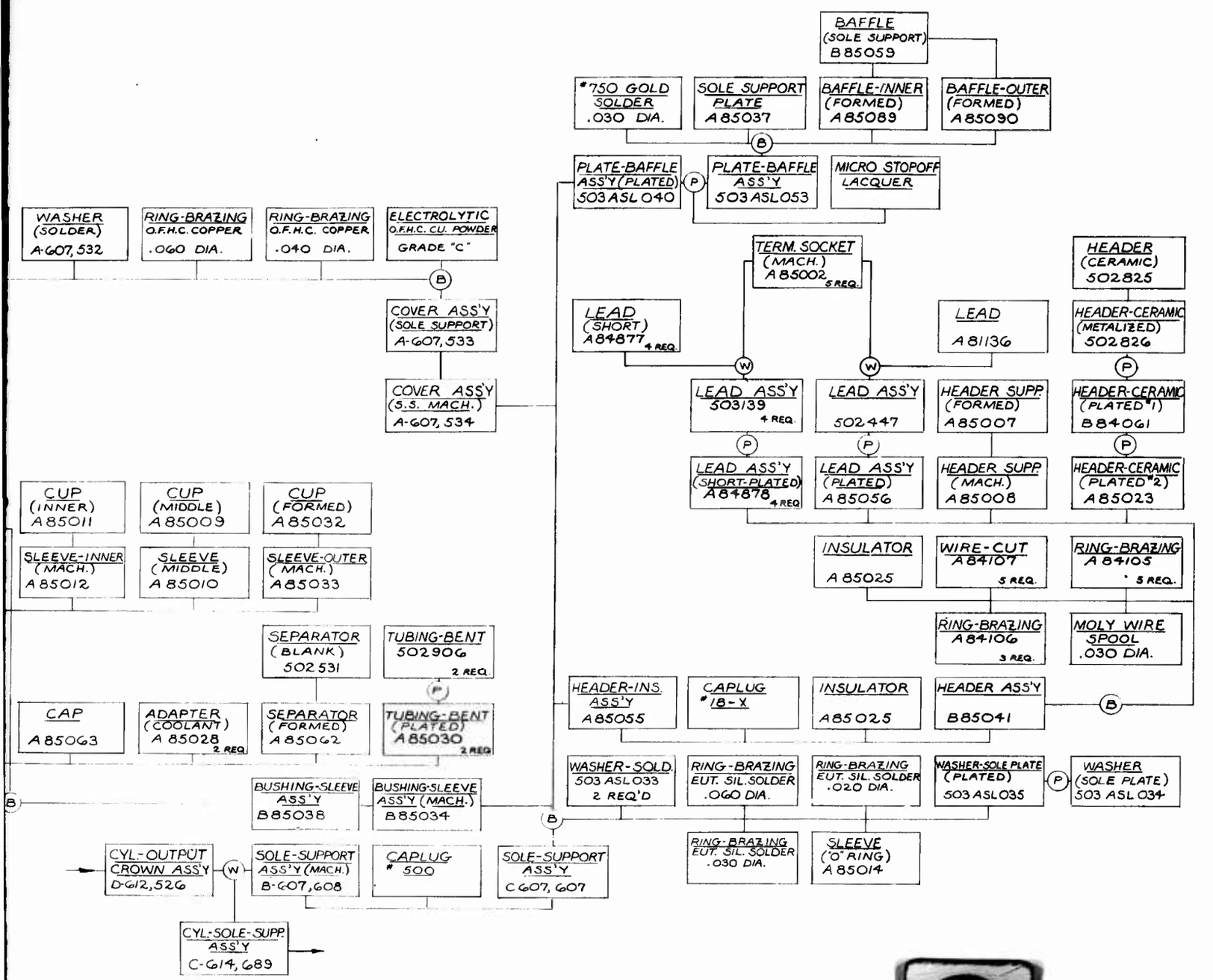
QKA 851

2



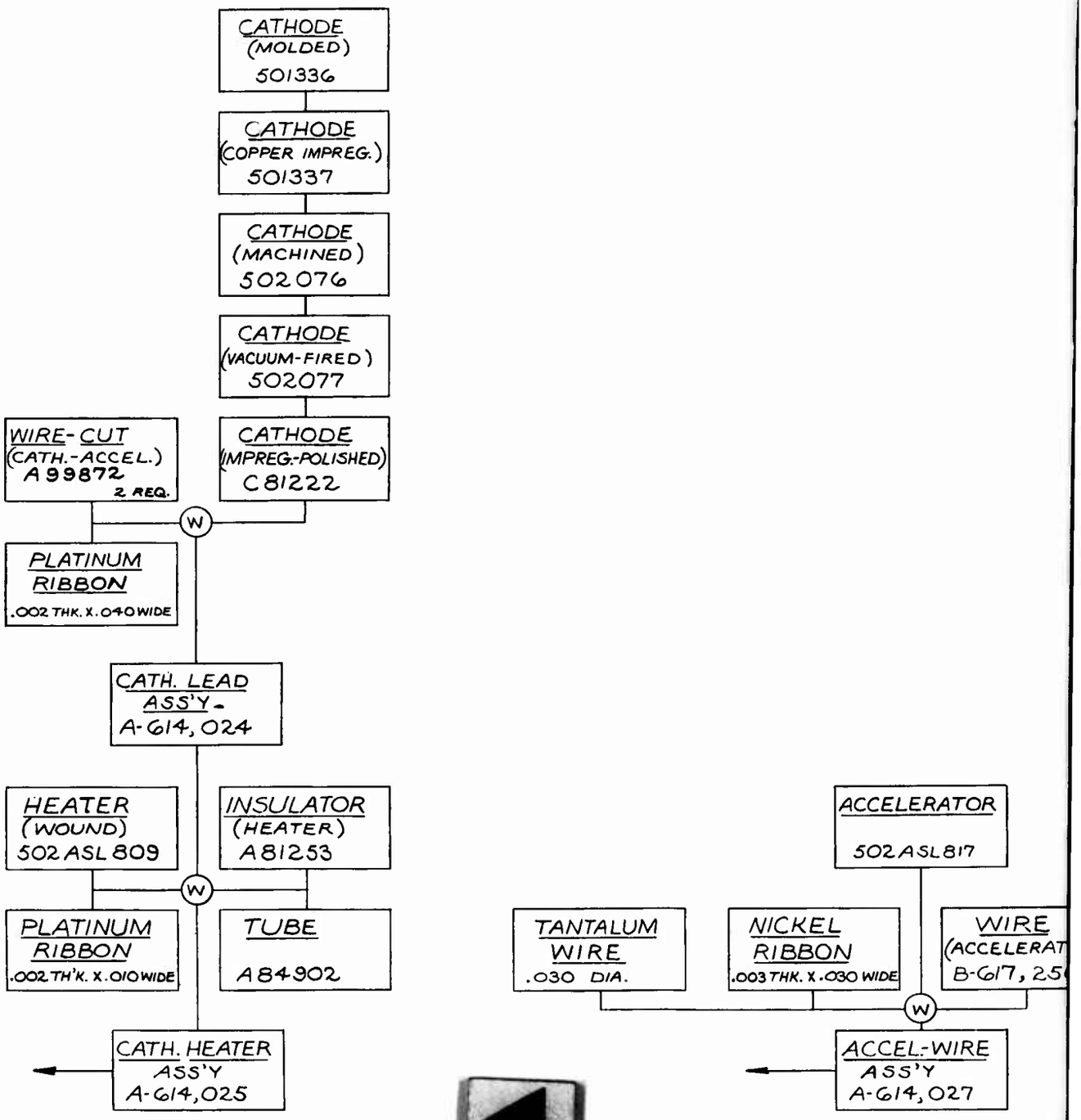
1

FLOW CHART
(CYL. SOLE SUPPORT ASS'Y)
QKA851



FLOW CHART
(CYL. SOLE SUPPORT ASS'Y)
QKA851

2

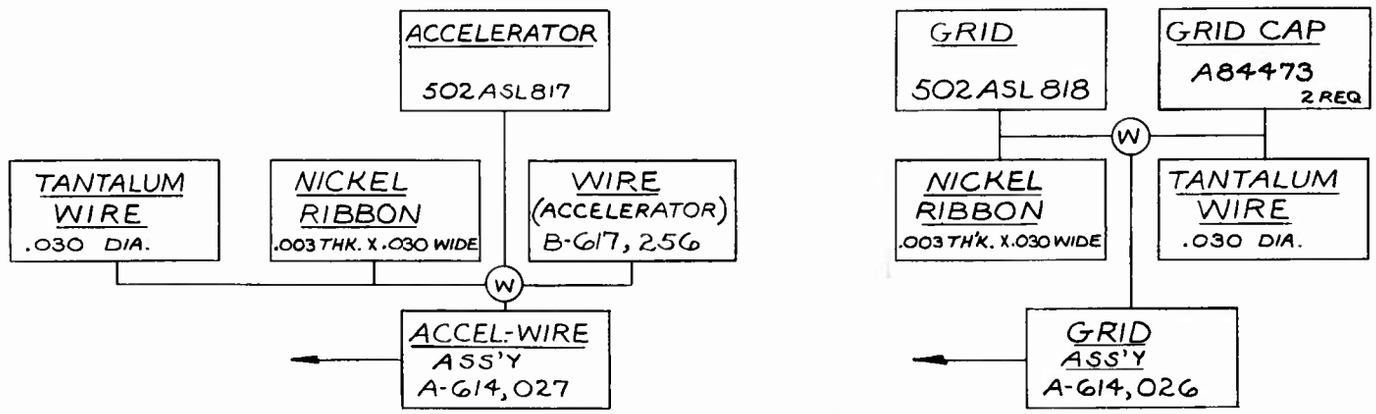


1

FLOW CHART

GUN ASS'Y

QKA851

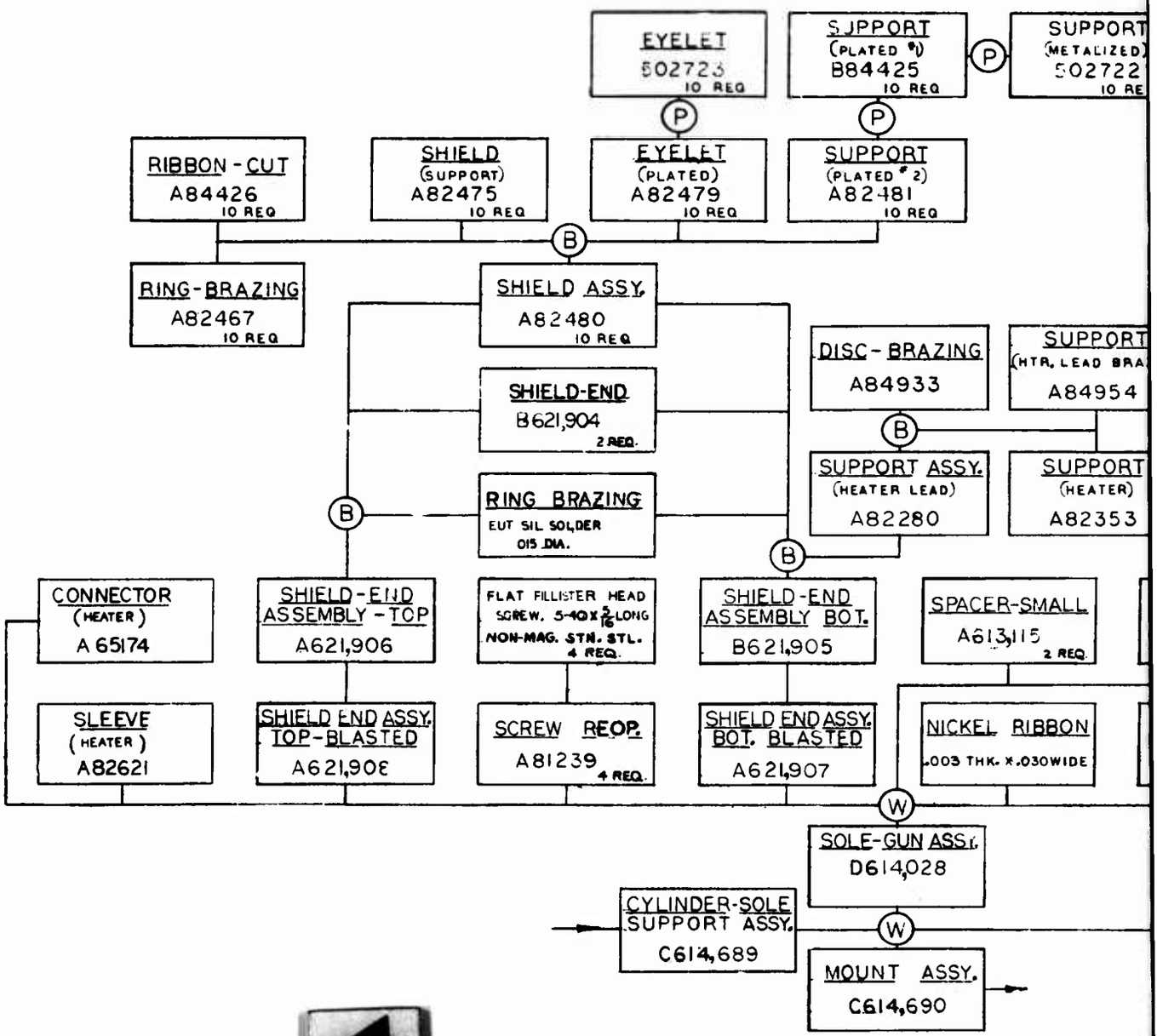


FLOW CHART

GUN ASS'Y

QKA851

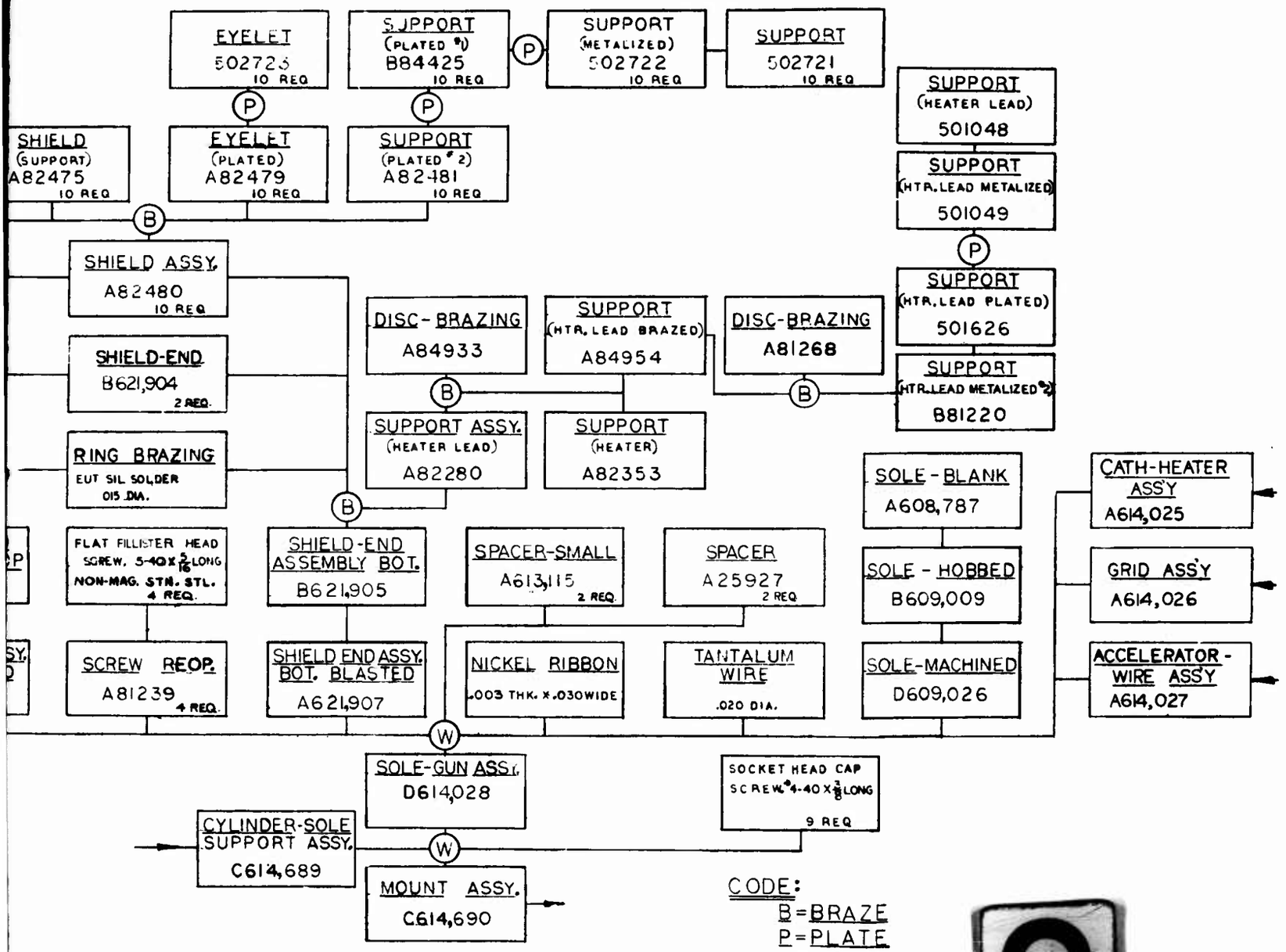
2



FLOW CHART

MOUNT ASSEMBLY

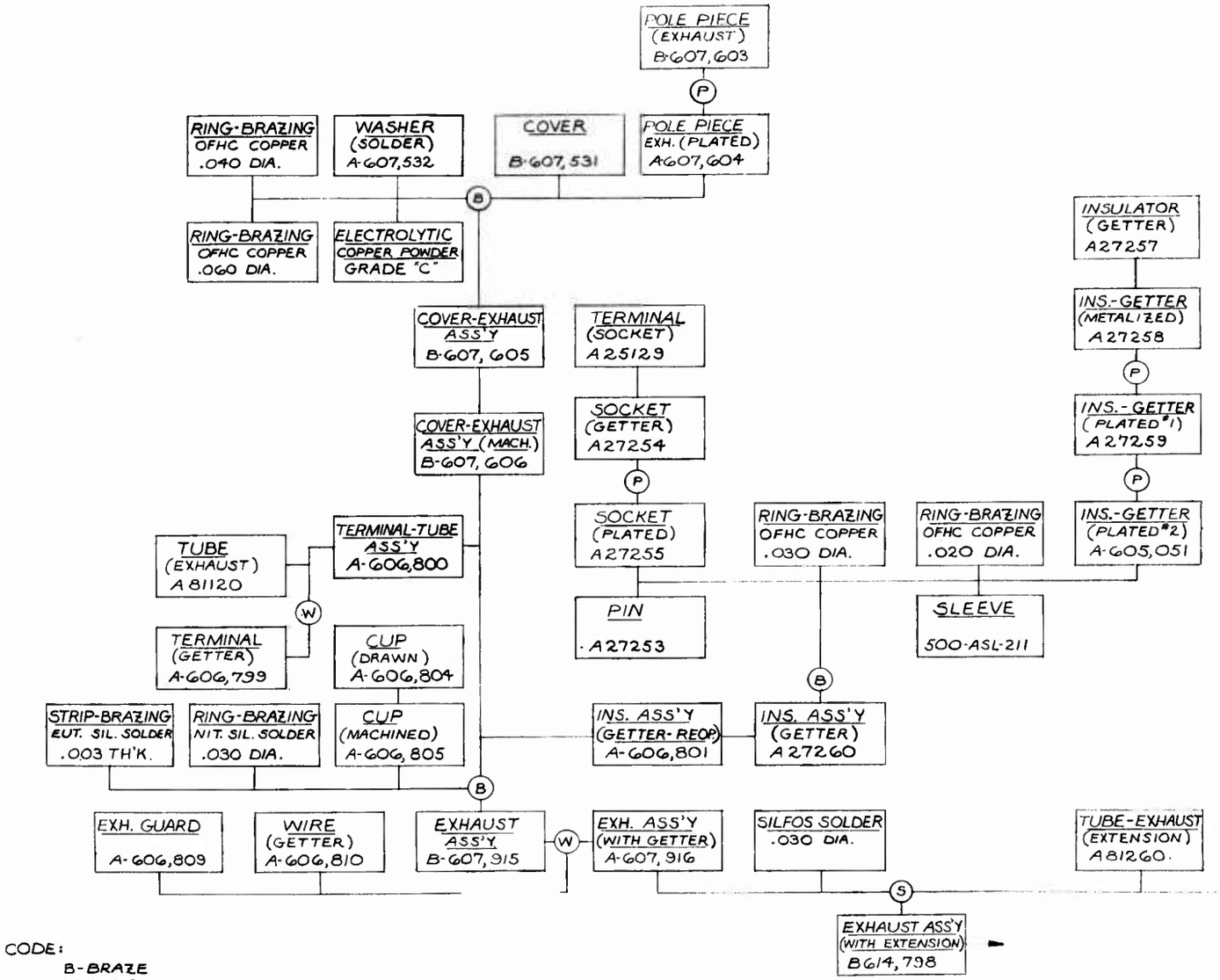
QKA 851



CODE:
B = BRAZE
P = PLATE
W = WELD

FLOW CHART
MOUNT ASSEMBLY
QKA 851

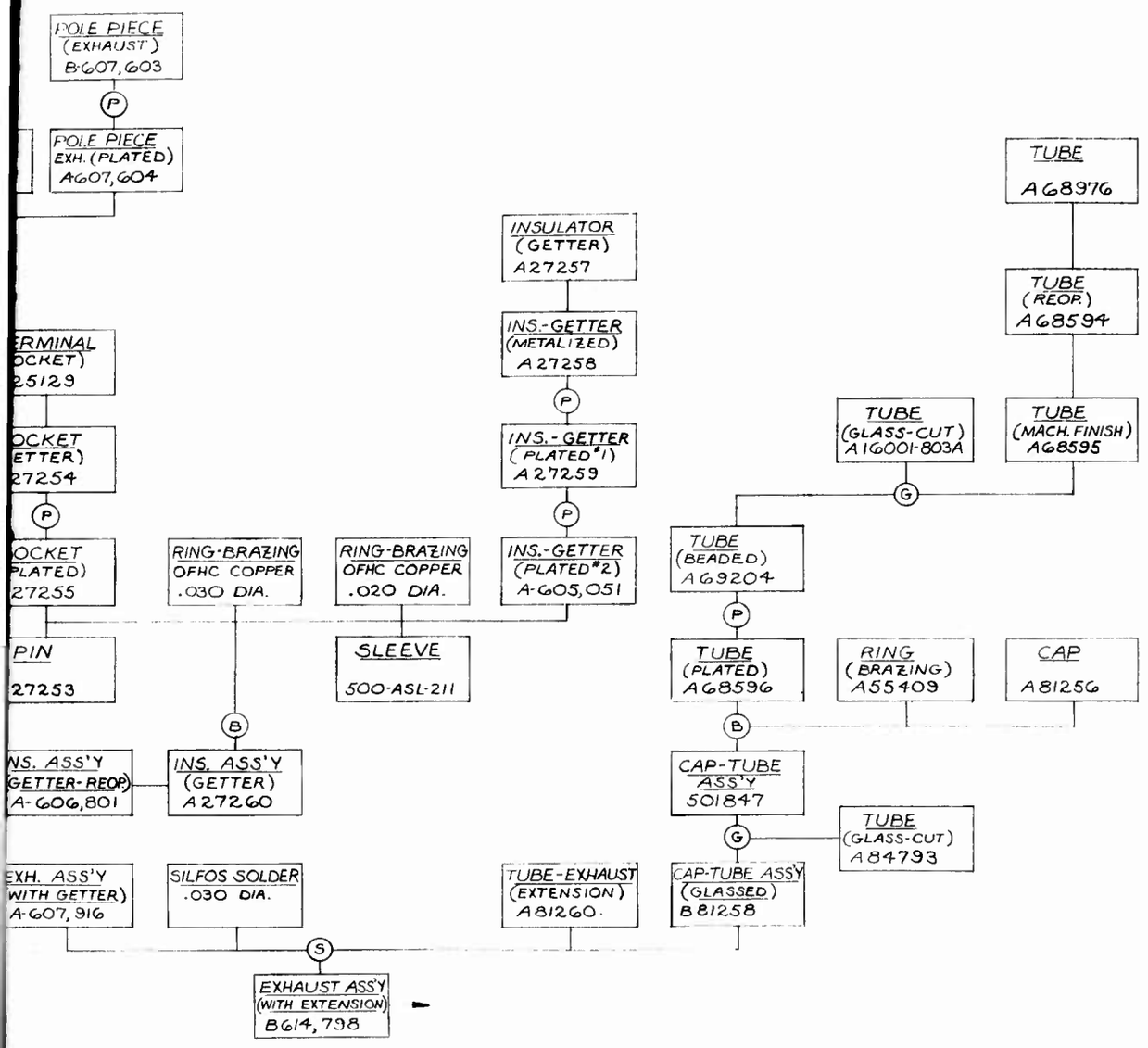
2



CODE:

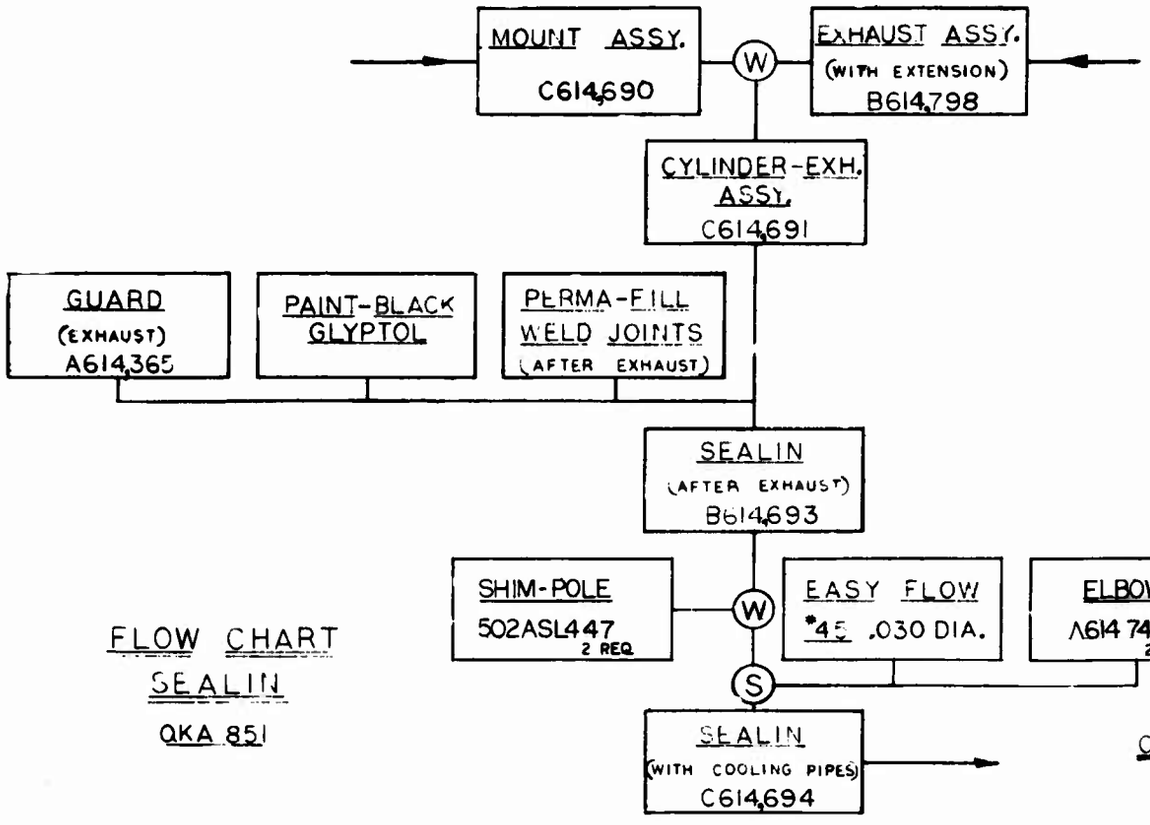
B- BRAZE
W- WELD
P- PLATED
G-GLASSED
S- SOLDER

FLOW CHART
(EXHAUST ASS'Y (WITH EXTENSION)
QKA 851



FLOW CHART
(EXHAUST ASS'Y (WITH EXTENSION)
QKA 851

2

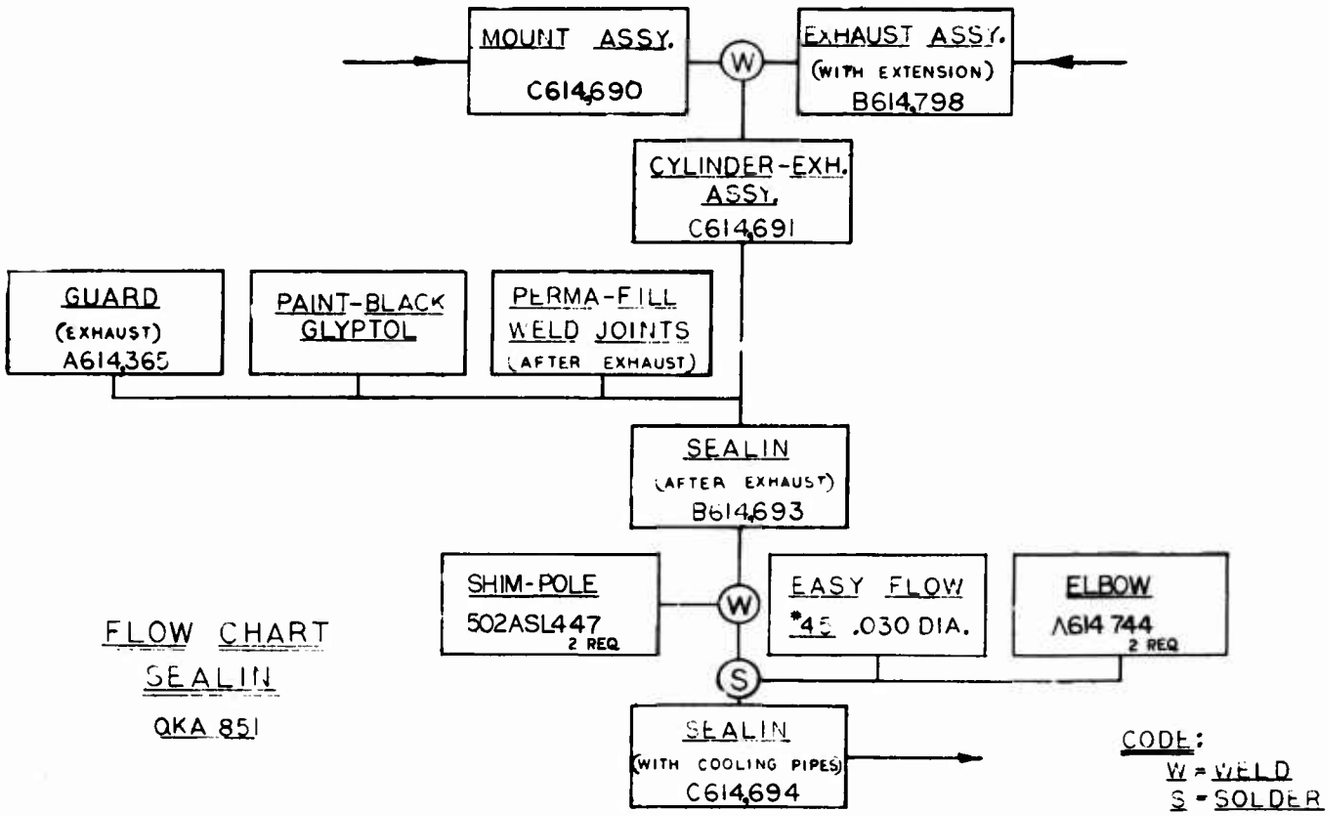


FLOW CHART

SEALIN

QKA 851

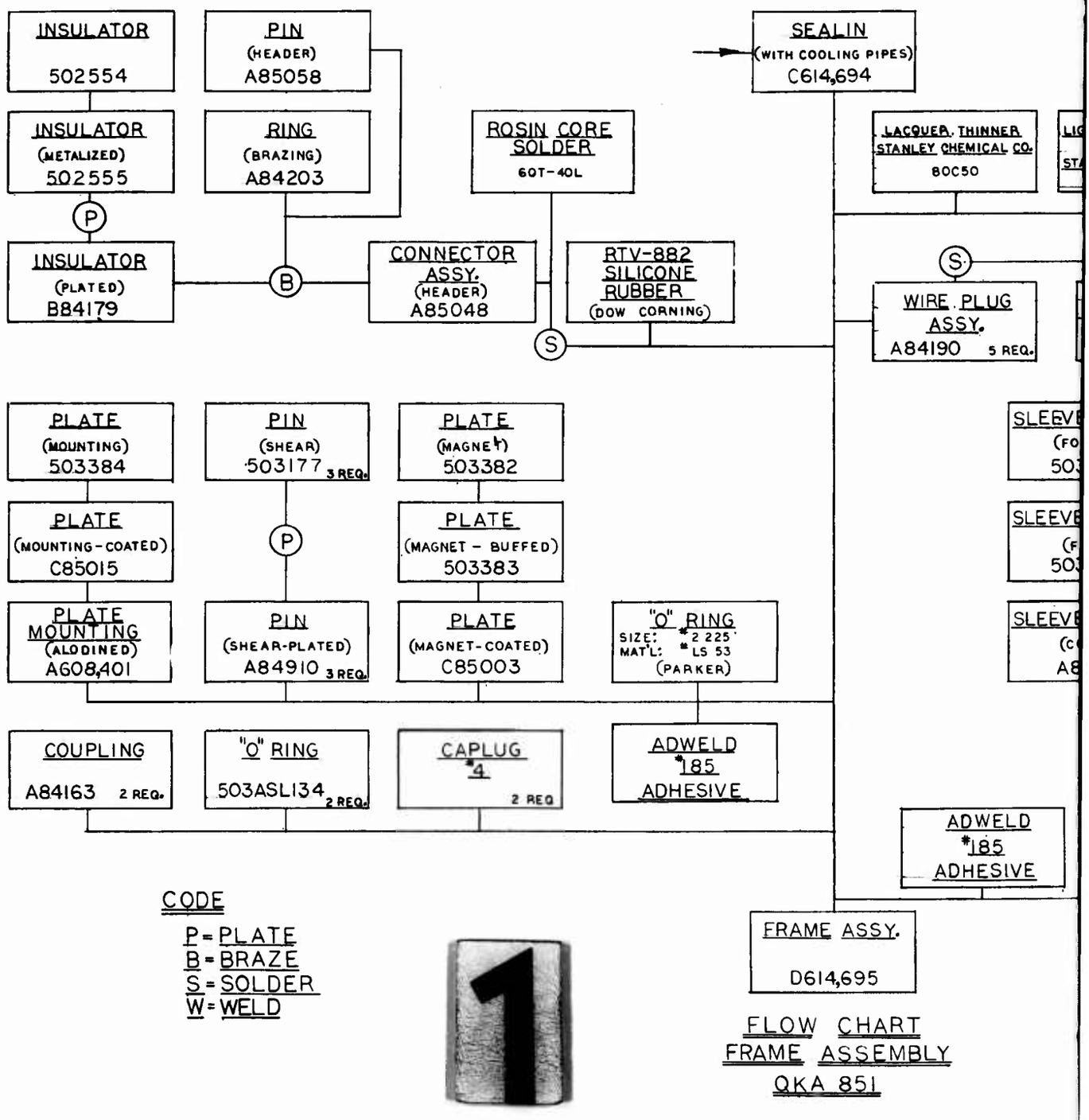
1



FLOW CHART
SEALIN
QKA 851

CODE:
W = WELD
S = SOLDER

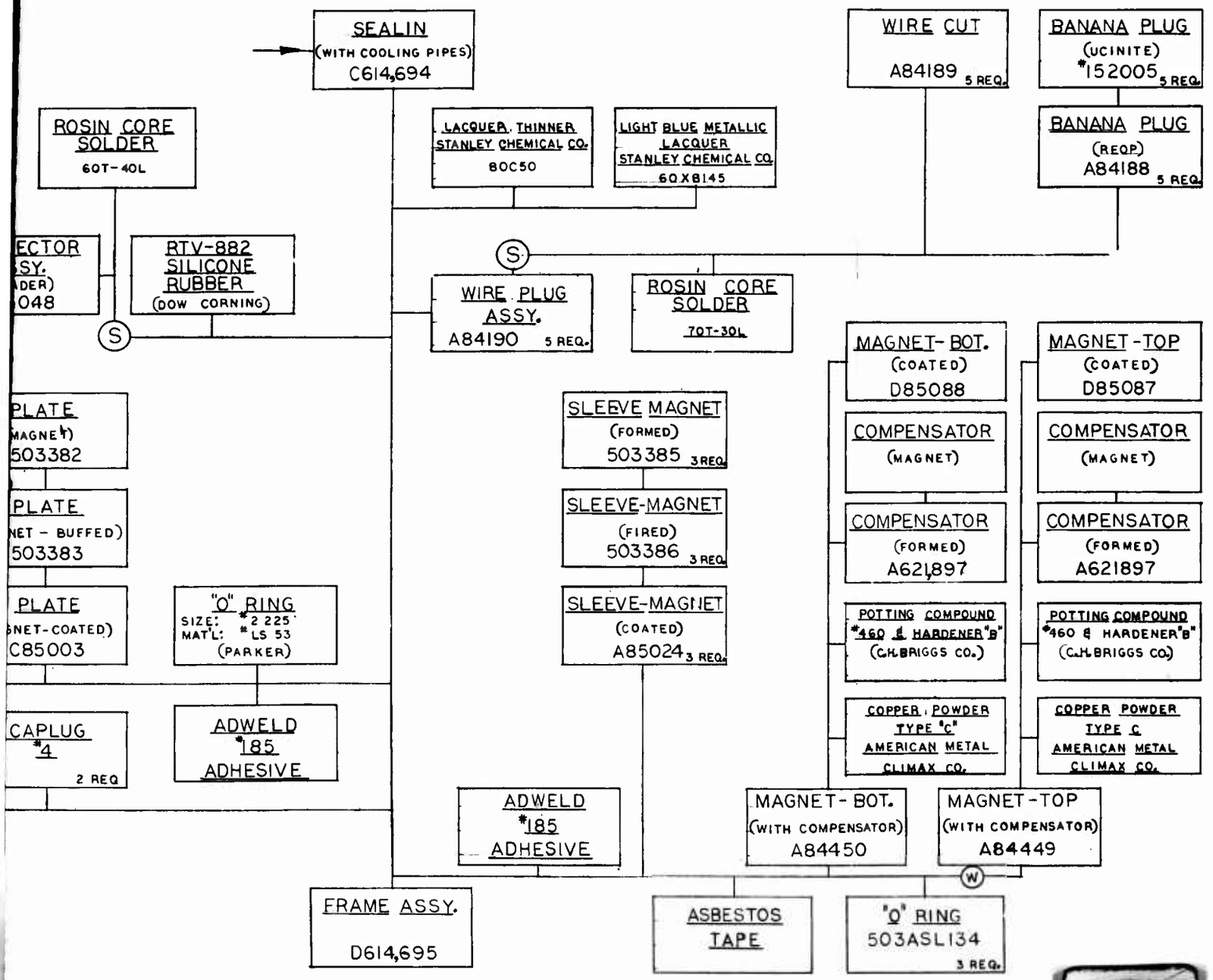
2



CODE

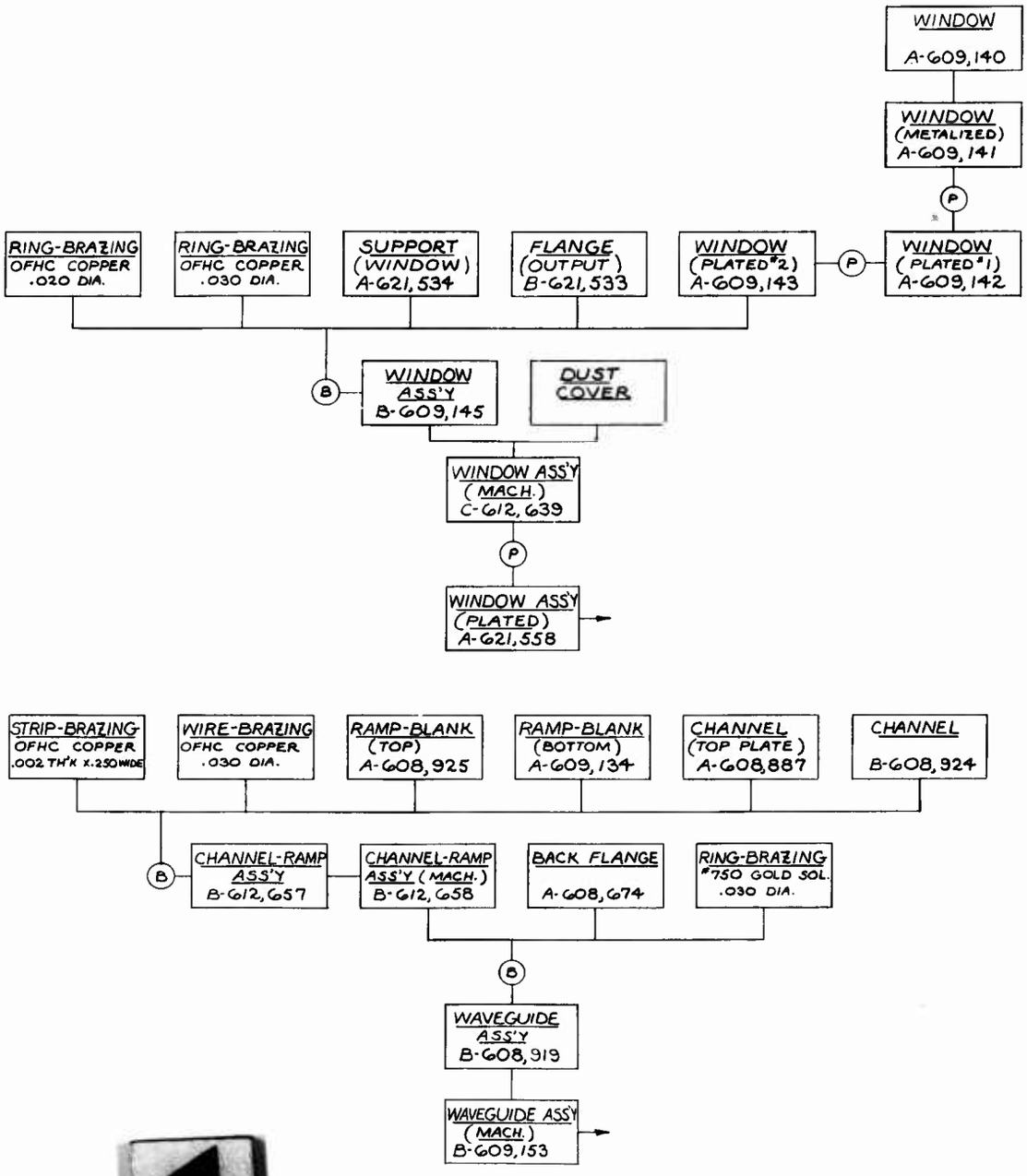
P = PLATE
B = BRAZE
S = SOLDER
W = WELD

FLOW CHART
FRAME ASSEMBLY
QKA 851

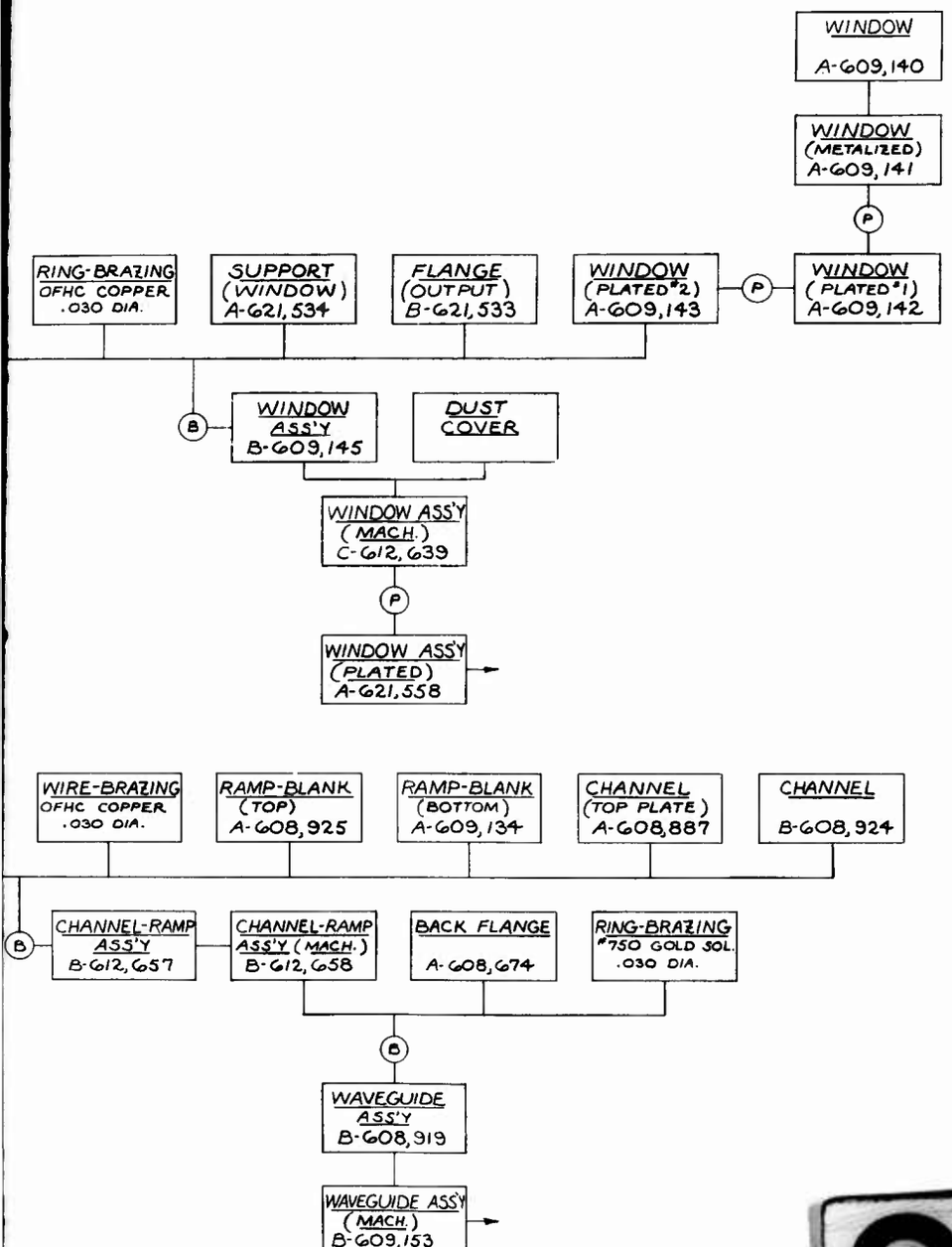


FLOW CHART
FRAME ASSEMBLY
QKA 851

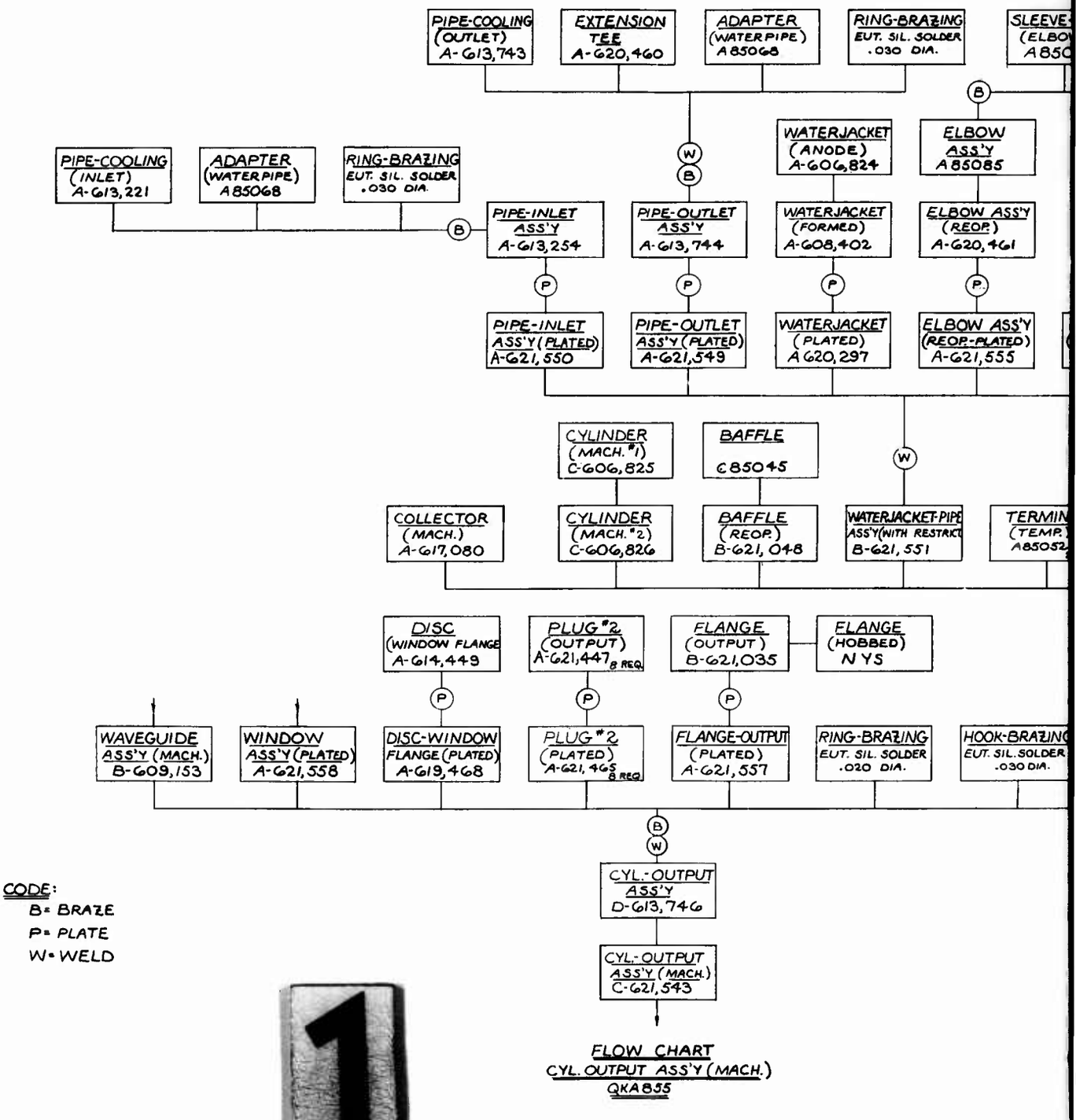
2



FLOW CHART
WAVEGUIDE ASS'Y (MACH.)
WINDOW ASS'Y (PLATED)
QKA855



FLOW CHART
WAVEGUIDE ASS'Y (MACH.)
WINDOW ASS'Y (PLATED)
QKA855

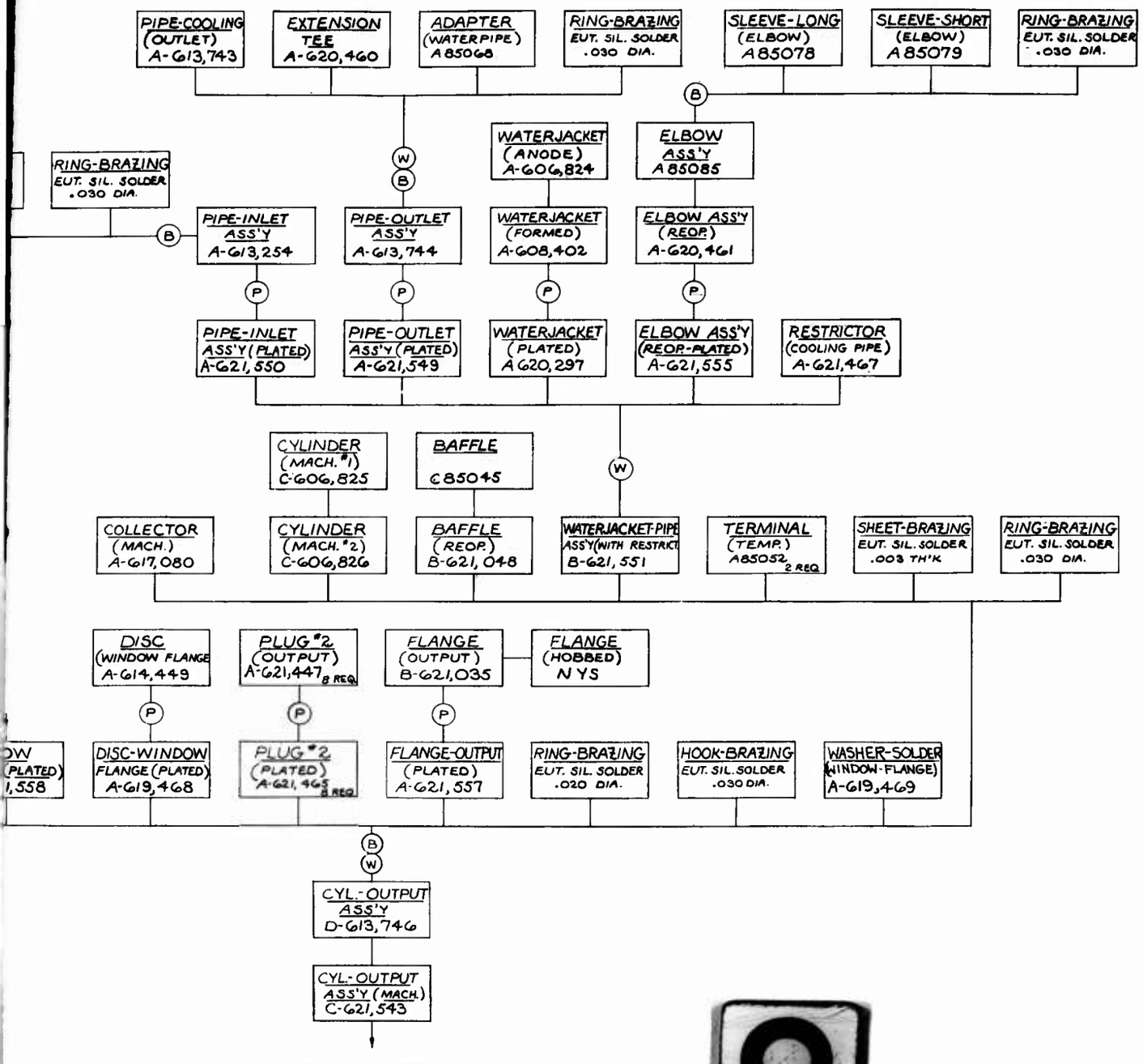


CODE:

B = BRAZE

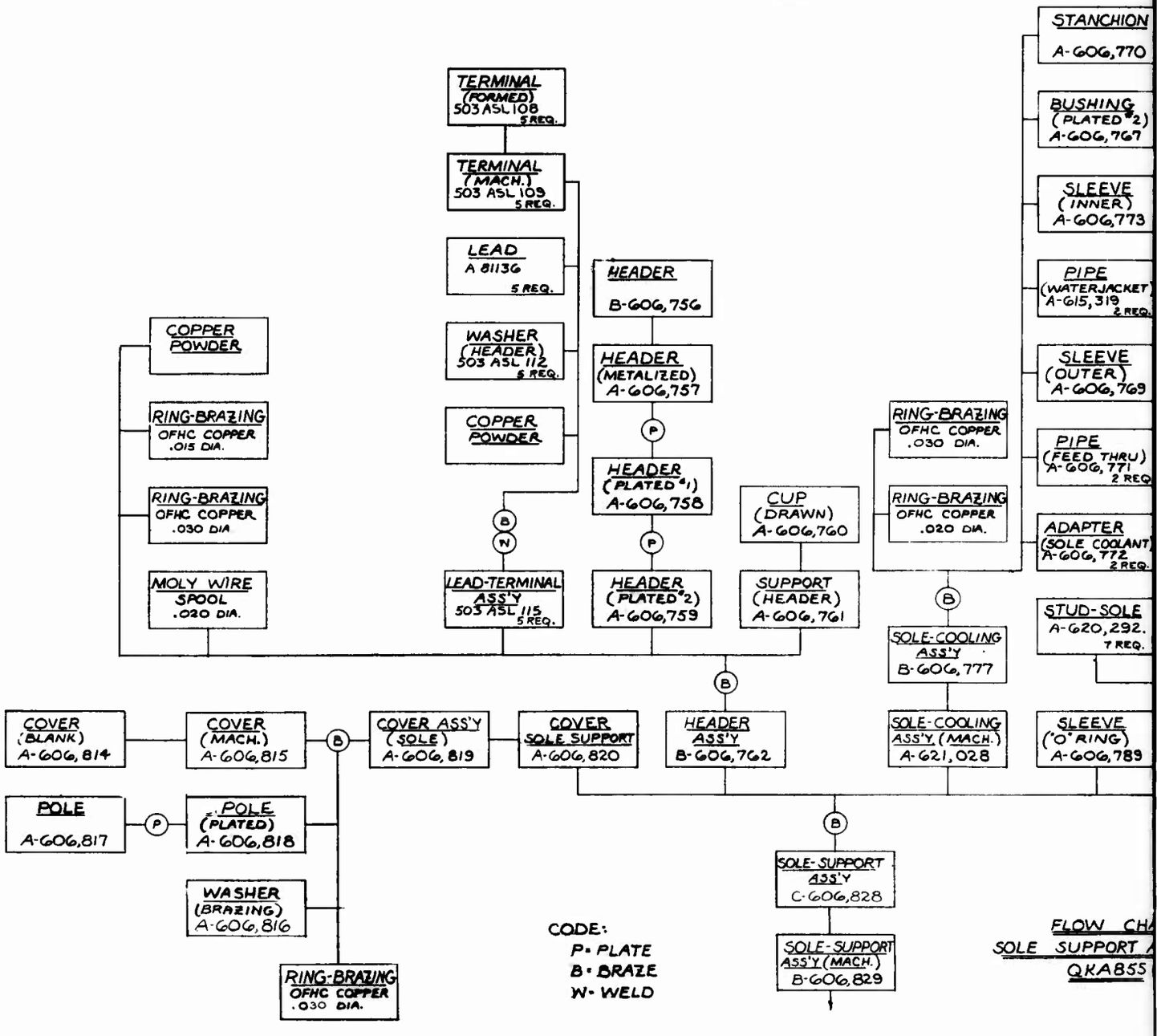
P = PLATE

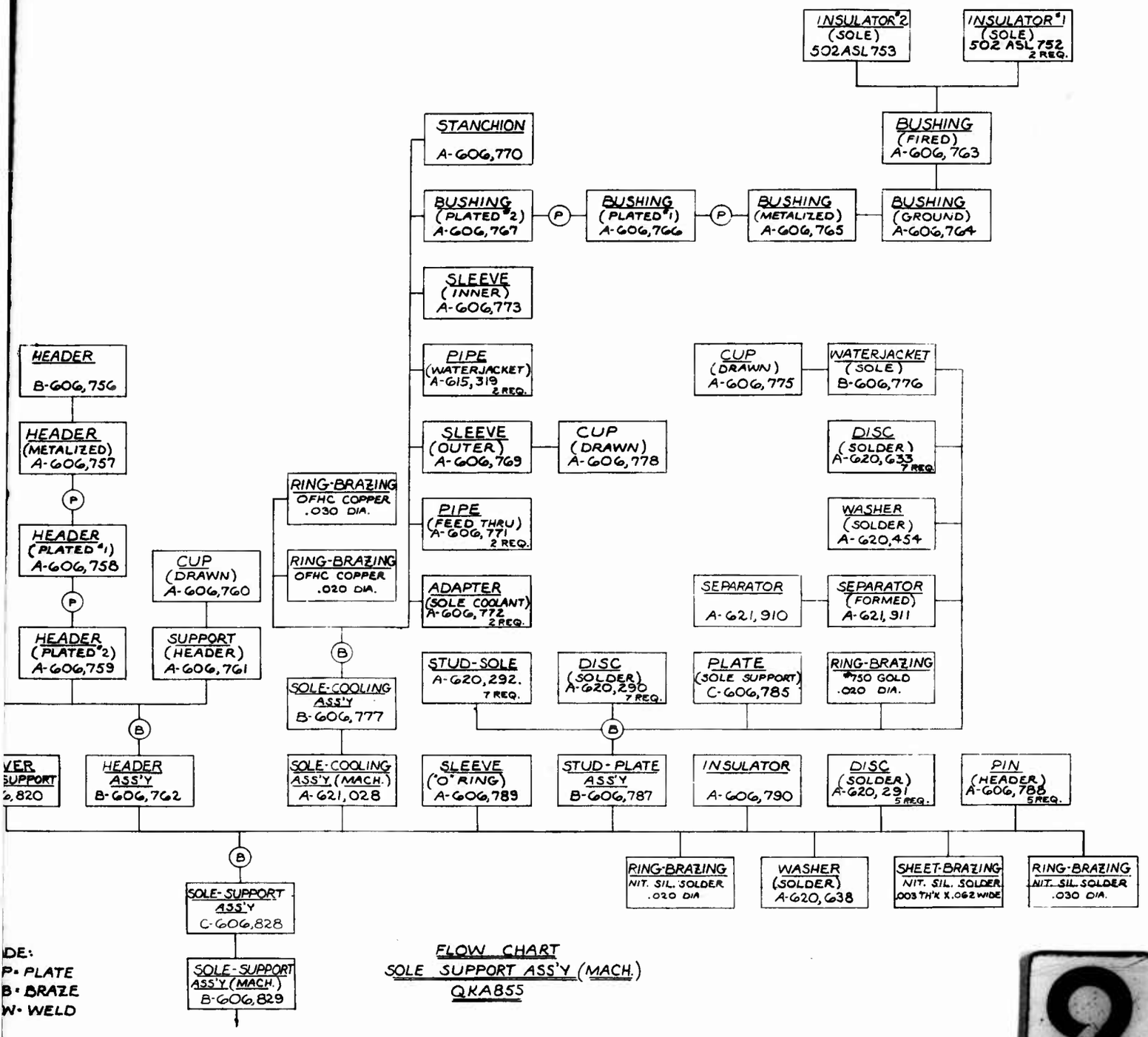
W = WELD



FLOW CHART
CYL. OUTPUT ASS'Y (MACH.)
QKA855

2

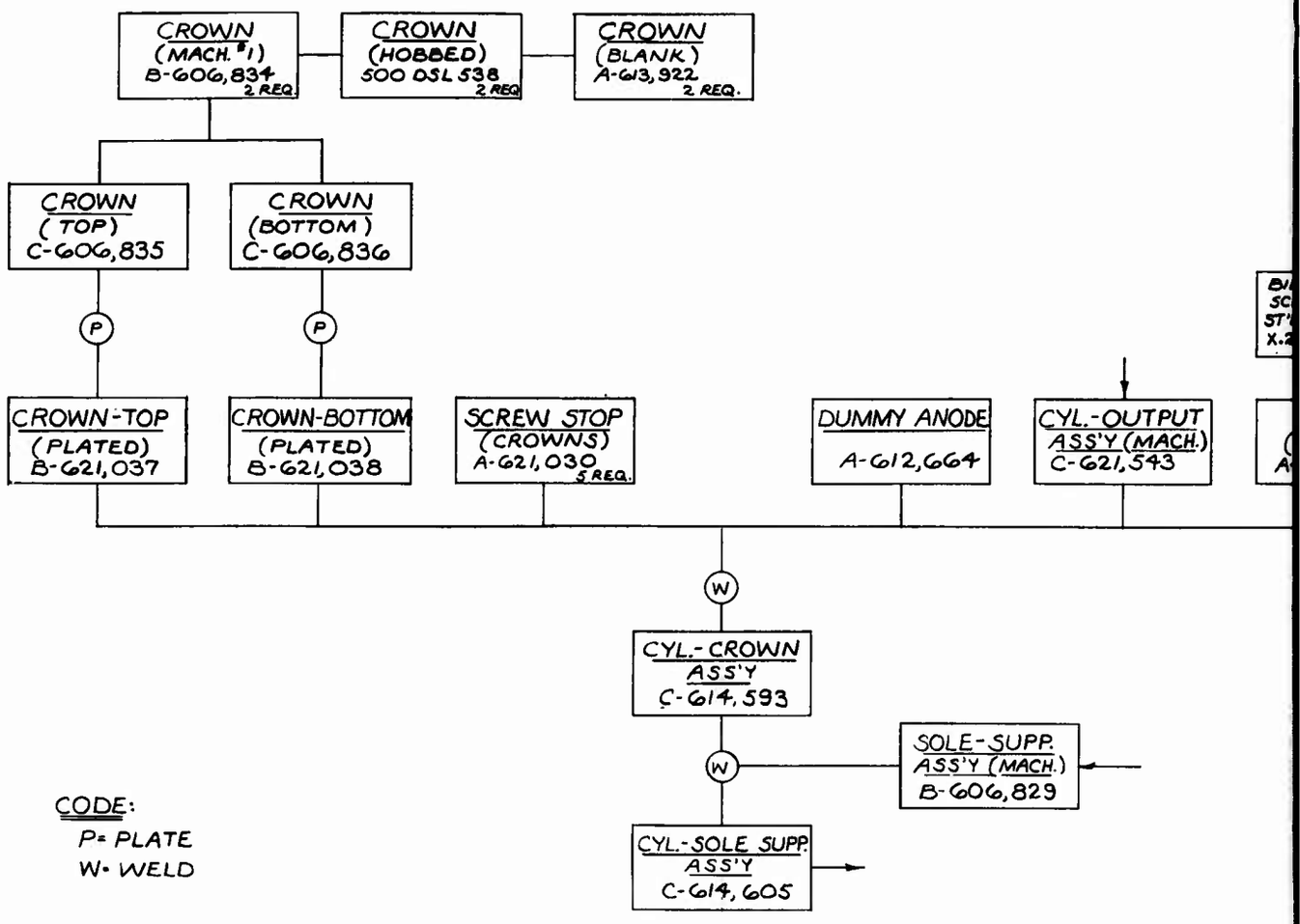

STANCHION
A-606,770
BUSHING
(PLATED *2)
A-606,767
SLEEVE
(INNER)
A-606,773
PIPE
(WATERJACKET)
A-615,319
2 REQ.
SLEEVE
(OUTER)
A-606,769
PIPE
(FEED THRU)
A-606,771
2 REQ
ADAPTER
(SOLE COOLANT)
A-606,772
2 REQ.
STUD-SOLE
A-620,292.
7 REQ.
TERMINAL
(FORMED)
503 ASL 108
5 REQ.
TERMINAL
(MACH.)
503 ASL 109
5 REQ.
LEAD
A 81136
5 REQ.
WASHER
(HEADER)
503 ASL 112
5 REQ.
COPPER
POWDER
HEADER
B-606,756
HEADER
(METALIZED)
A-606,757
HEADER
(PLATED *1)
A-606,758
HEADER
(PLATED *2)
A-606,759
COPPER
POWDER
RING-BRAZING
OFHC COPPER
.015 DIA.
RING-BRAZING
OFHC COPPER
.030 DIA
MOLY WIRE
SPOOL
.020 DIA.
LEAD-TERMINAL
ASS'Y
503 ASL 115
5 REQ.
CUP
(DRAWN)
A-606,760
SUPPORT
(HEADER)
A-606,761
RING-BRAZING
OFHC COPPER
.030 DIA.
RING-BRAZING
OFHC COPPER
.020 DIA.
SOLE-COOLING
ASS'Y
B-606,777
SOLE-COOLING
ASS'Y (MACH.)
A-621,028
SLEEVE
('O' RING)
A-606,789
COVER
(BLANK)
A-606,814
COVER
(MACH.)
A-606,815
COVER ASS'Y
(SOLE)
A-606,819
COVER
SOLE SUPPORT
A-606,820
HEADER
ASS'Y
B-606,762
POLE
A-606,817
POLE
(PLATED)
A-606,818
WASHER
(BRAZING)
A-606,816
RING-BRAZING
OFHC COPPER
.030 DIA.
SOLE-SUPPORT
ASS'Y
C-606,828
SOLE-SUPPORT
ASS'Y (MACH.)
B-606,829
CODE:
P- PLATE
B- BRAZE
W- WELD
FLOW CH
SOLE SUPPORT A
QKA855



DE:
P - PLATE
B - BRAZE
W - WELD

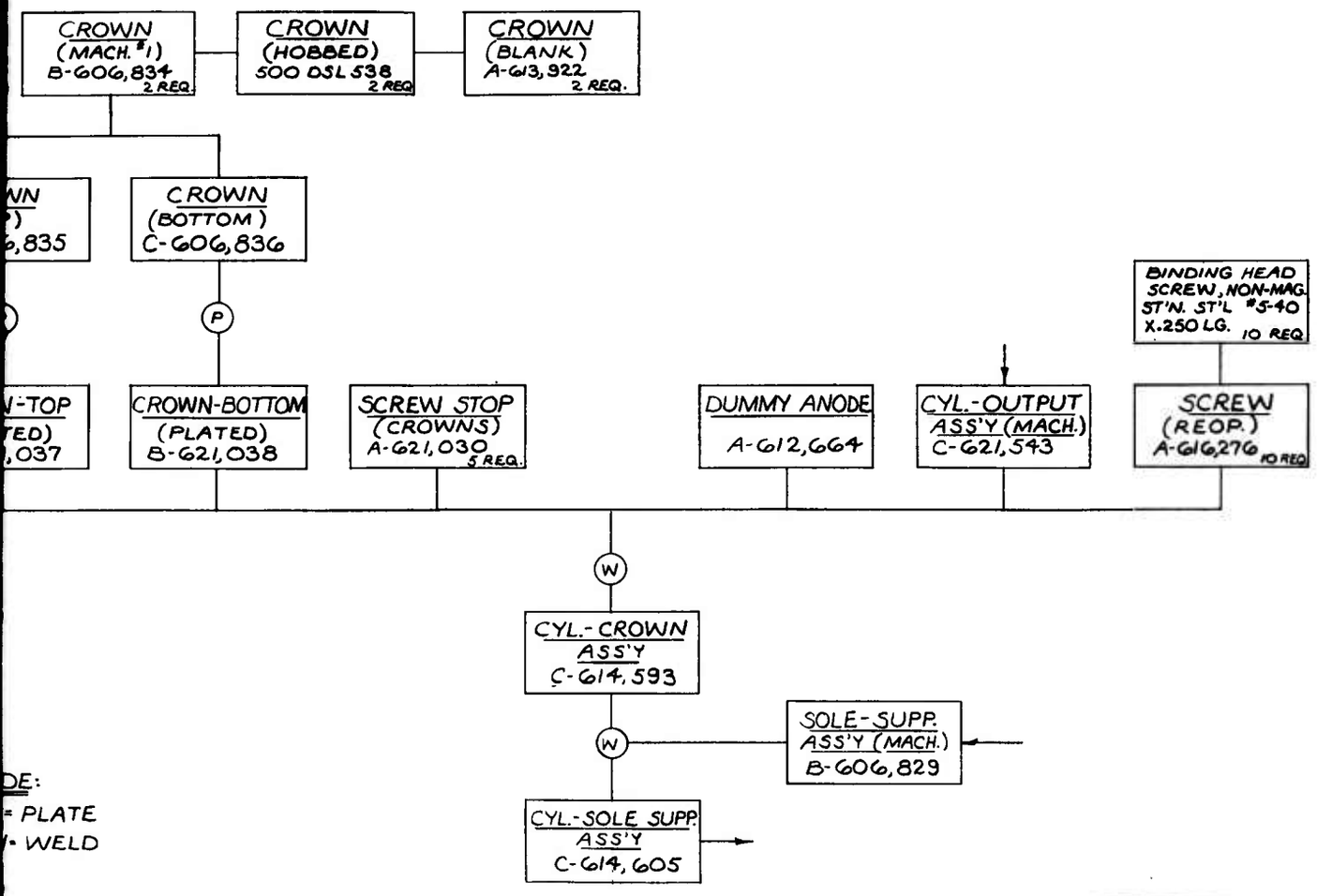
FLOW CHART
SOLE SUPPORT ASS'Y (MACH.)
QKA855

2



CODE:
P= PLATE
W= WELD

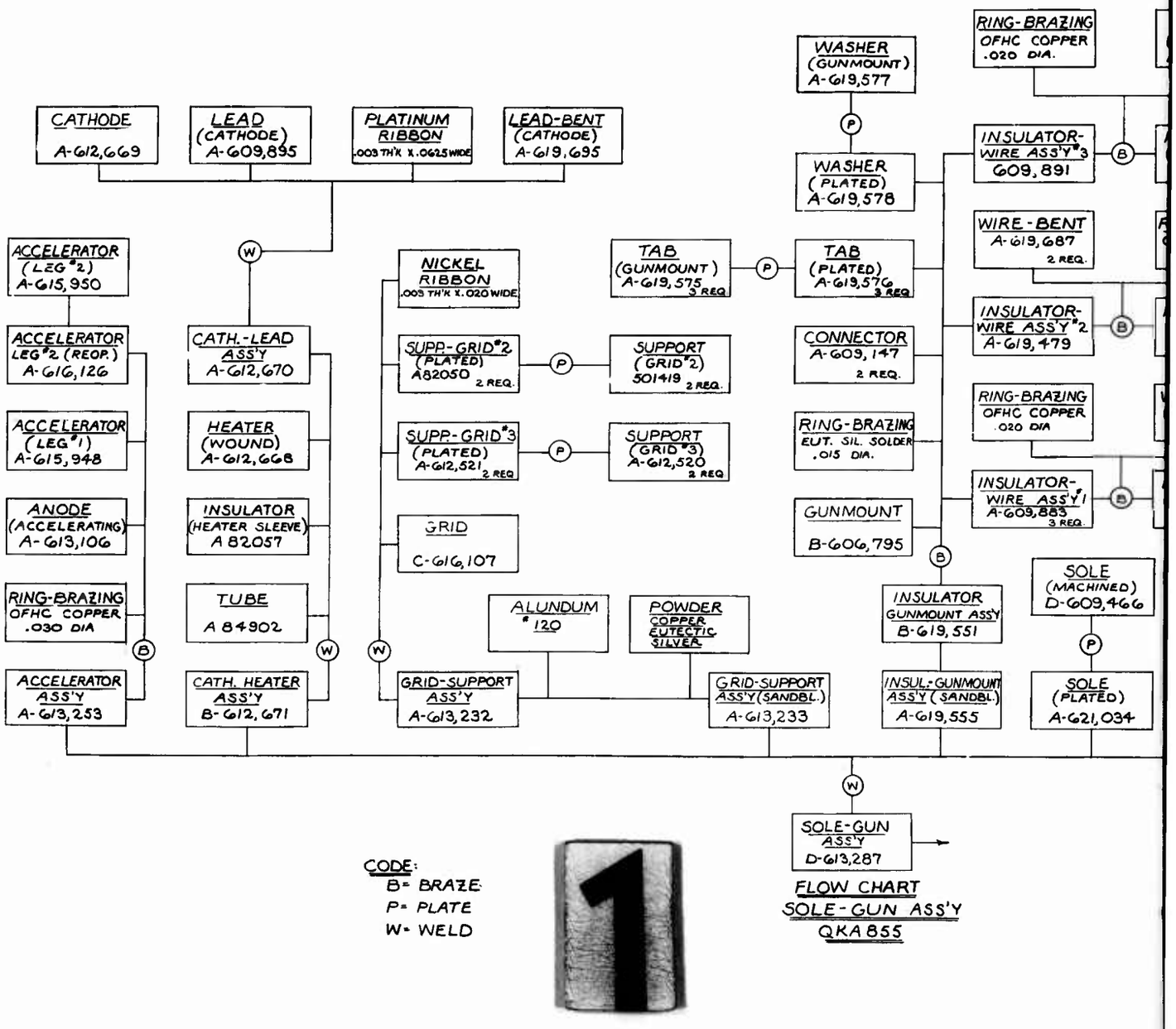
FLOW CHART
CYL. SOLE SUPPORT ASS'Y
QKA855



DE:
= PLATE
= WELD

FLOW CHART
CYL. SOLE SUPPORT ASS'Y
QKA855

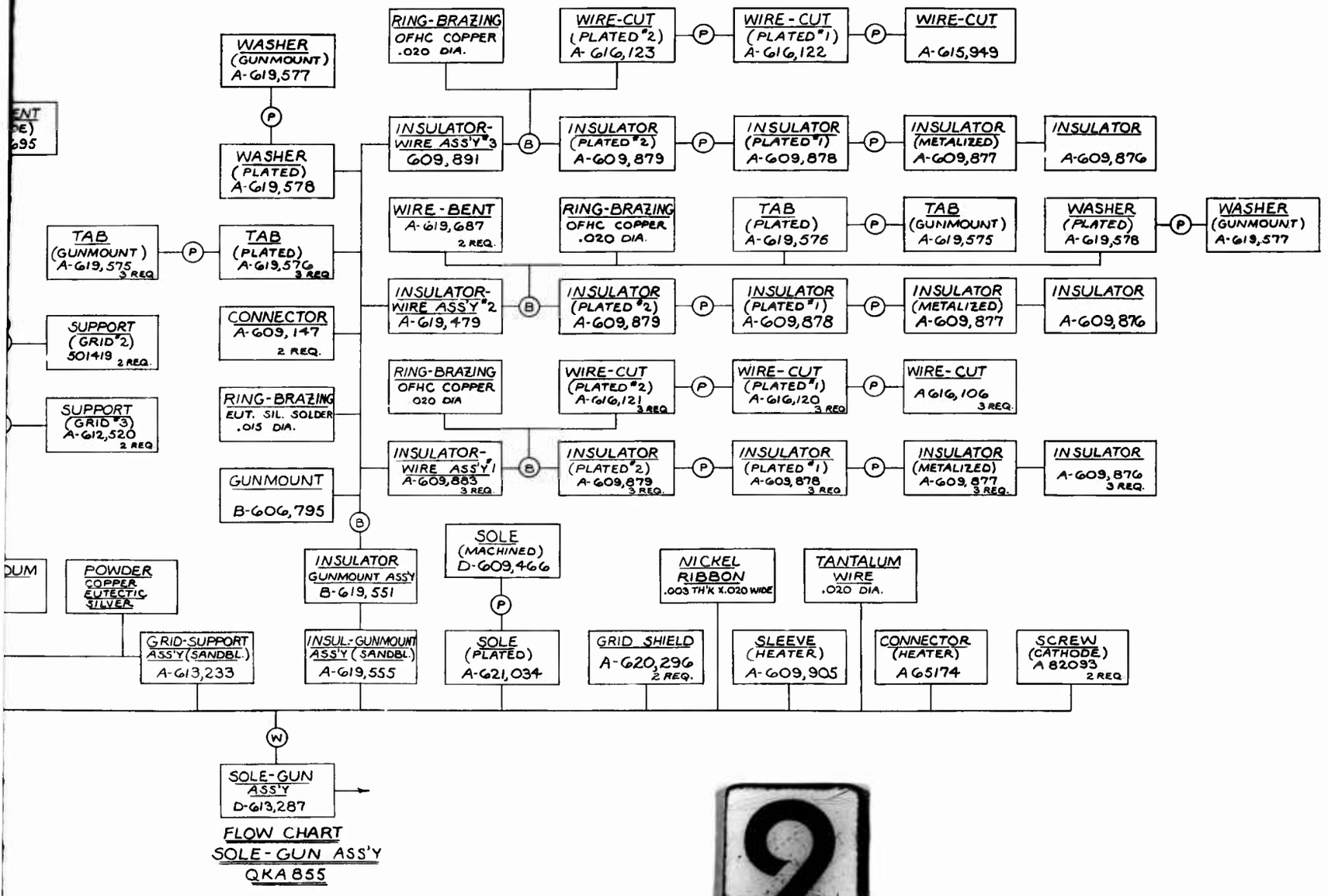
2



CODE:
B = BRAZE
P = PLATE
W = WELD

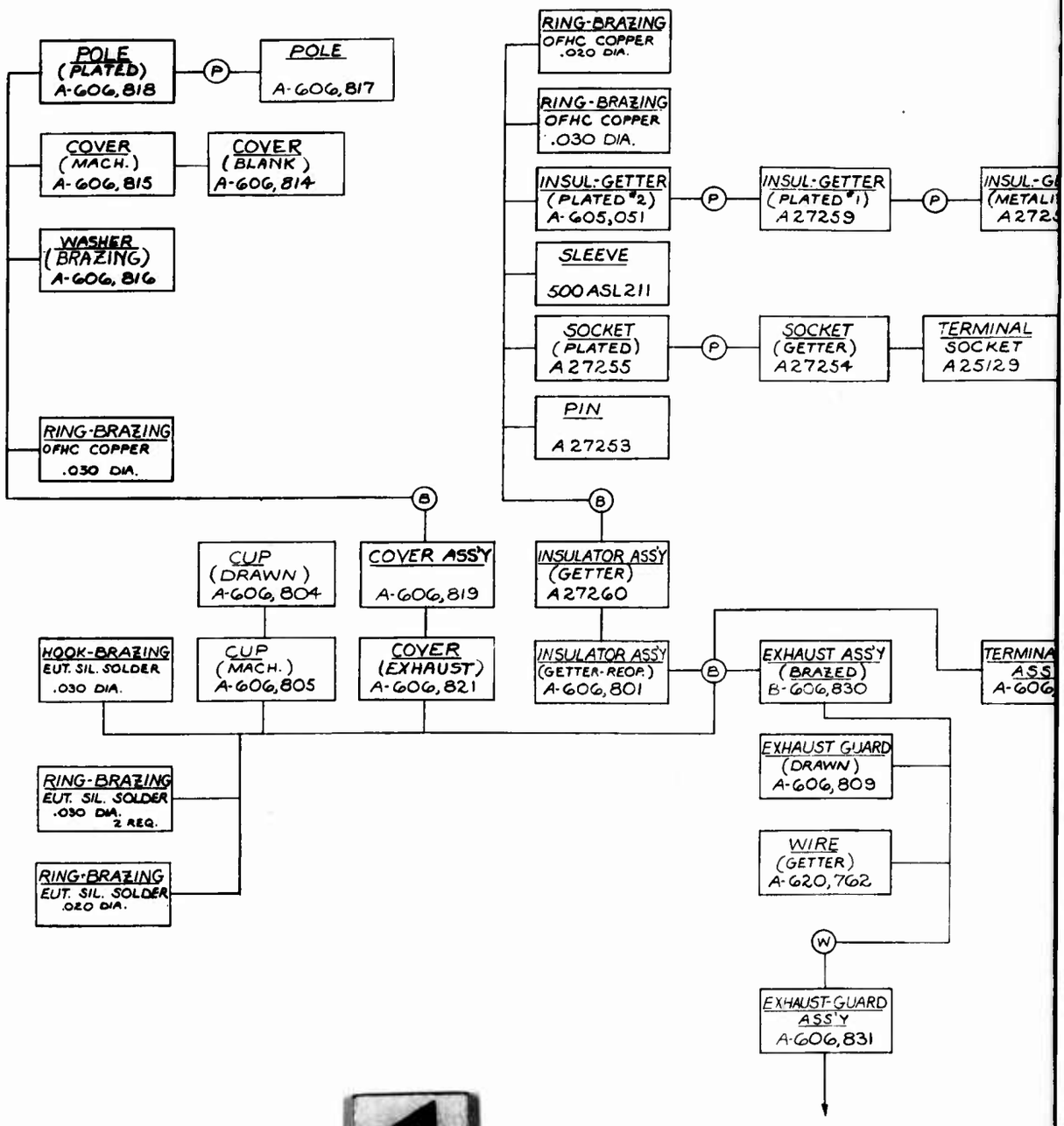
1

FLOW CHART
SOLE-GUN ASS'Y
QKA 855



FLOW CHART
SOLE-GUN ASS'Y
QKA855

2

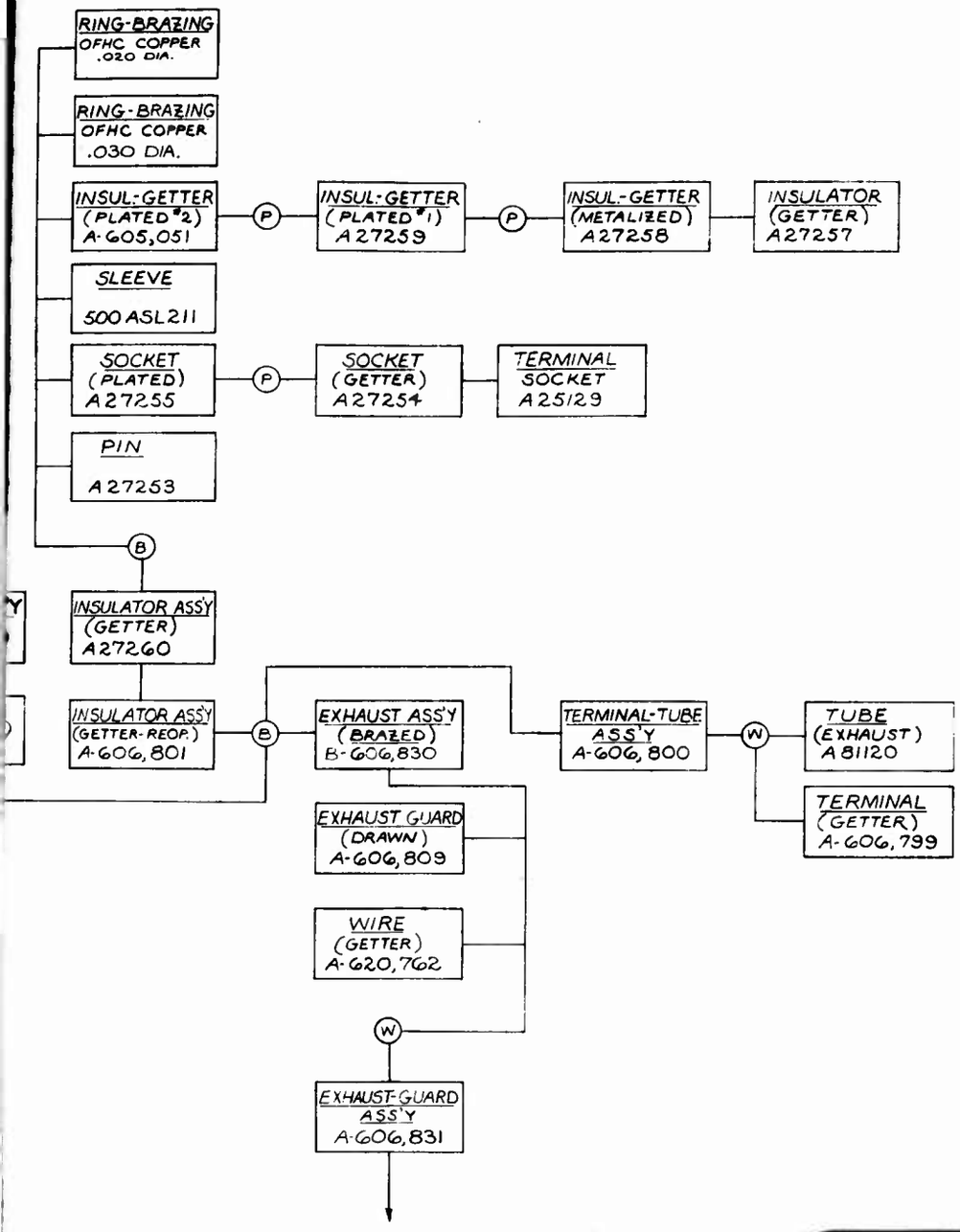


CODE:

B- BRAZE
W- WELD
P- PLATE

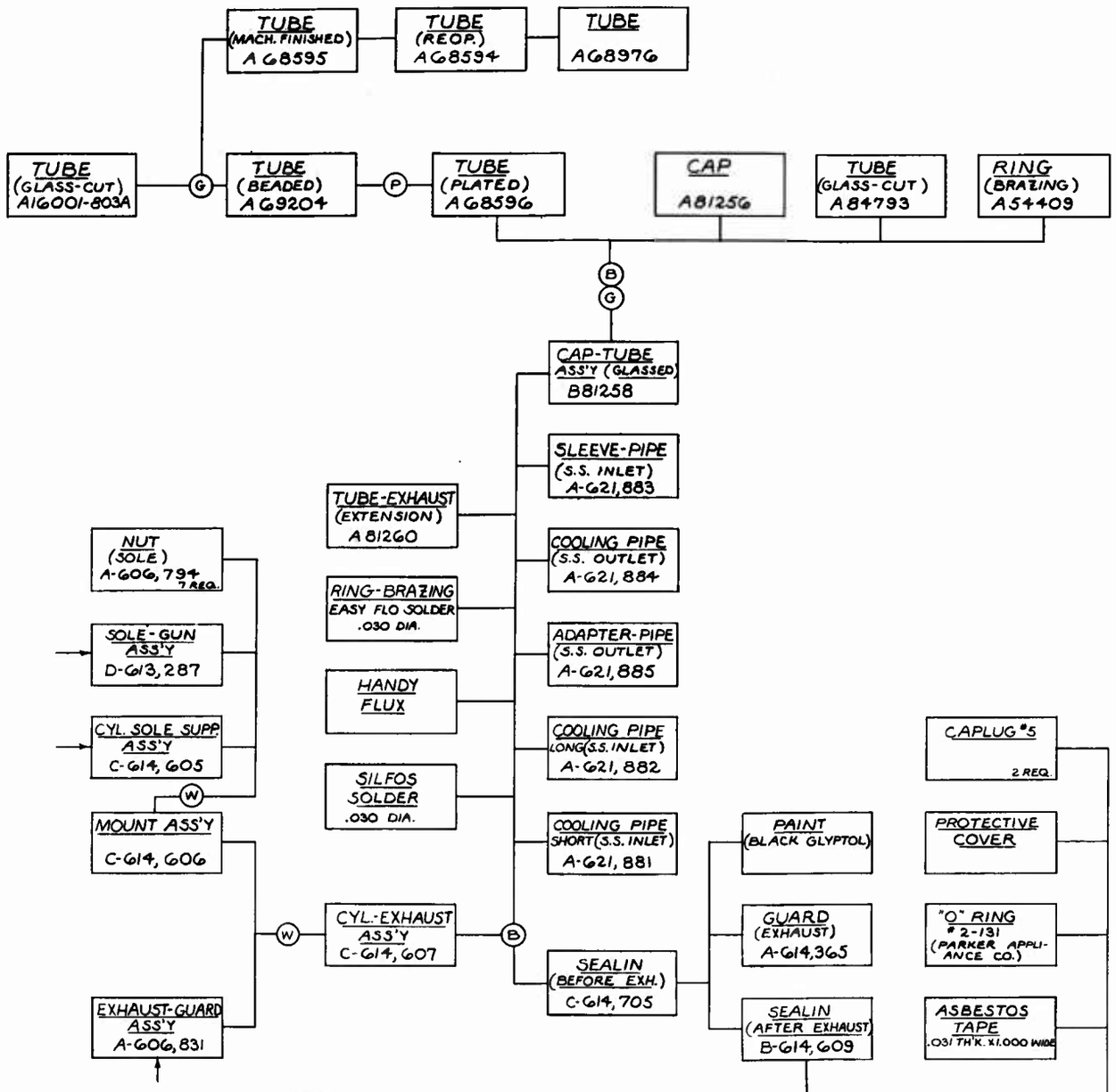
1

FLOW CHART
EXHAUST-GUARD ASS'Y
QKA855



FLOW CHART
EXHAUST-GUARD ASS'Y
QKA855

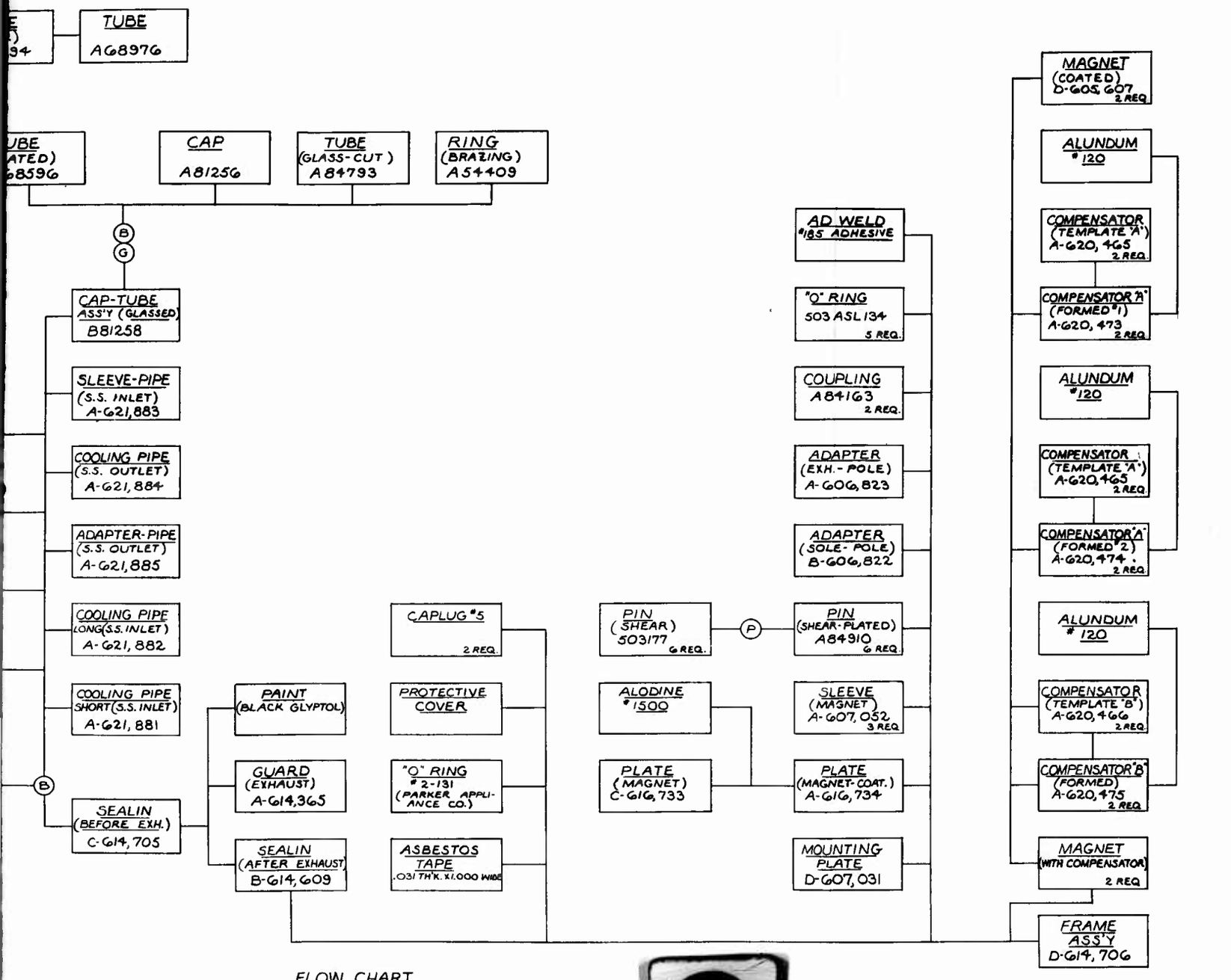
2



CODE:
B = BRAZE
P = PLATE
G = GLASS
W = WELD

1

FLOW CHART
FINAL ASS'Y
QKA855



FLOW CHART
FINAL ASS'Y
QKA855

2

APPENDIX III

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DISTRIBUTION LIST

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Office, Director Defense Research and Engineering Office, Communications and Electronics ATTN: Lt Col C. G. Henline, U. S. A. (Ret) Rm 3D 1037, The Pentagon Washington 25, D. C.	1
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UNCLASSIFIED Report

Appendix I - M-BWO Design and Test Specifications.

Appendix II - Family Process Specifications.

Appendix III - Distribution List

UNCLASSIFIED

1. Backward-Wave Oscillators (Family of)
2. Electronic Tube Devices
I. Project 7-695A
II. Contract No. AF33(600)43395
III. Raytheon Company Spencer Laboratory Burlington, Mass.
IV. Peter Janis James Gallagher
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Electronics Branch Manufacturing Technology Division, Air Force Materials Laboratory, Research and Technology Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio.
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